THE

AMERICAN NATURALIST.

VOL. XIX.—*NOVEMBER*, 1885.—No. 11.

EXAMPLES OF ICONOCLASM BY THE CONQUERORS OF MEXICO.

BY W. H. HOLMES.

THE two great centers of aboriginal American culture, Mexico and Peru, were the first to feel the shock of the conquest, and the native peoples, together with their arts and institutions, sank at once into irretrievable ruin. Temples, sculptures and paintings, the tangible representatives of an idolatrous worship, excited the hatred of a fanatical priesthood, and were, as nearly as possible, swept from the face of the land. The fiercely intolerant spirit of the representatives of the church is well illustrated by the language of a letter written by Zumarraga, the chief inquisitor of Mexico, to the Franciscan chapter at Tolosa, in January, 1531. The words are as follows: "Very reverend Father be it known to you that we are very busy in the work of converting the heathen; of whom, by the grace of God, upwards of one million have been baptized at the hands of the brethren of the order of our Seraphic Father, Saint Francis; five hundred temples have been leveled to the ground, and more than twenty thousand figures of the devils they worshiped have been broken to pieces and burned."[1]

There was, however, a limit to the power of destruction. Many of the greater monuments have defied the destroyer and stand to-day and will stand for ages to come as illustrations of the power and culture of their builders. There were probably few works more difficult to destroy or wholly deface than those found

[1] Quoted by Bancroft, Native Races, Vol. II, p. 171.

upon the summit of the justly famed hill of Texcocingo, a favorite resort of the most enlightened rulers of Texcoco.

This *cerro* is upwards of 600 feet in height, and is a narrow ridge, nearly a mile in length, that projects into the valley of Mexico from the range forming its eastern rim. From Texcoco it assumes a somewhat conical shape as indicated in the accompanying sketch, Fig. 1. The upper part is very steep, exhibiting cliffs and huge detached masses of a coarse pinkish-gray moderately hard rock, usually called porphyry, that proves, upon examination under the microscope, to be a variety of andesite. This hill has been the witness of many important and thrilling events in pre-Spanish as well as in Spanish times. It gives unmistakable evidence of having been at one time literally covered

FIG. 1.—Hill of Texcocingo from Texcoco.

with artificial structures, and numerous recesses, niches, stairways and cisterns have been hewn in the living rock. It was a sad day to the despairing Texcocan when he saw his deities tossed over the cliffs, his shrines desecrated, and at the same time beheld afar off, across the plain, the smoke rising from the burning of his sacred records.

At the present time this wonderful hill is almost denuded of its artificial features. There remain but traces of walls and floors, the deep recesses cut in the solid rock and the great battered boulders that were once the images of gods, to tell imperfectly the story of a blasted culture.

Among the most interesting of these remnants is a recess a short distance below the summit on the side facing Texcoco, and indicated by the middle cross in the accompanying sketch. It still retains evidences of its original character and functions. In

the first place it must be described in detail. In beginning an edifice or apartment on the face of the hill, it was necessary first to prepare a floor by cutting a niche into the rock and filling out the level with masonry and cement[1] until a proper platform was secured. The back wall was formed entirely of the living rock and afforded the opportunity of carving out the deity who was to preside over the place. The side walls are partially of the rock in place, and were completed by the addition of heavy masonry, portions of which are still to be seen.

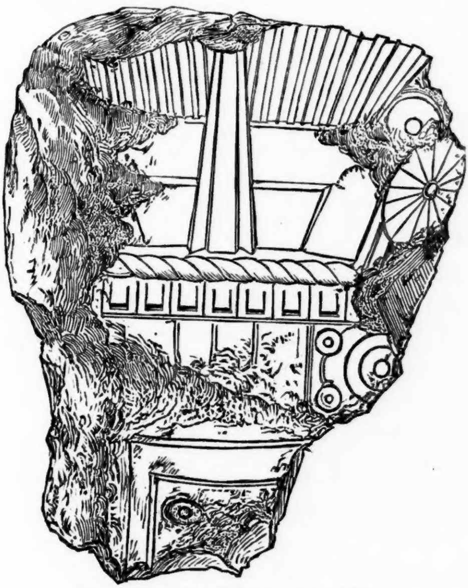

FIG. 2.—Sketch of fragment of idol.

On the floor of this recess I came upon a large fragment of rock that exhibited evidence of having been elaborately sculptured, and which at first suggested the figures peculiar to the calendar stones of the museum at Mexico. The fragment is nearly four feet long, by about three wide and half that thick. The sculpture is confined to one face, the sides and back showing rather fresh irregular fracture.

In making a sketch of the block I observed first that the figures were not symmetrically arranged and not truly radiate, and

[1] A common lime-sand cement, as determined by Professor F. W. Clark.

that a number of the features resembled the ornaments and trappings characteristic of the head-dresses commonly seen in Aztec sculpture. This led to the search for other features, and finally to the discovery of a partially obliterated eye toward the smaller end of the fragment. This convinced me that the object was part of the head of a huge idol. My sketch is reproduced in Fig. 2, but gives a very imperfect idea of the work, which in precision of execution and delicacy of finish equals anything of its class yet brought to my notice. It is a remarkable fact that the surface of the carving has been finished with a coat of red paint or enamel, which to this day exhibits a high polish, and is so

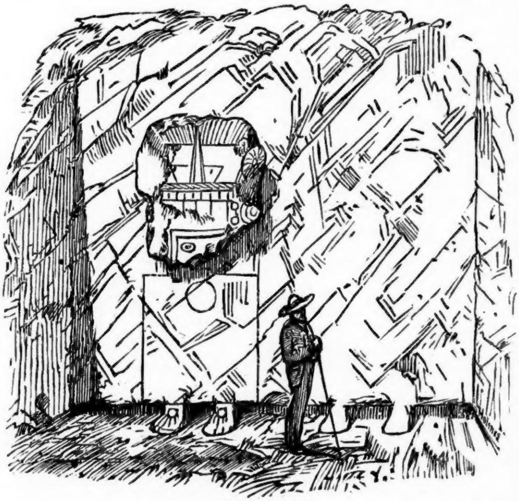

FIG. 3.—Probable position of the idol at the back of the niche.

firmly attached to the rock surface as to be removed with the greatest difficulty. The other portions of the figure have been broken up and carried away, or have been rolled down the side of the *cerro*. At first I was at a loss to imagine the original character and position of the figure to which the head belonged, but after a careful study of the recess I came to the conclusion that it had originally occupied the back wall of the recess, and that it had been carved from the rock in place. The proof of this was entirely satisfactory.

I observed first that the central part of the rear wall was not smoothly dressed, and that the rock surface showed compara-

tively recent fracture. In examining it closely I found at the base, as shown in the sketch, Fig. 3, an undercut channel, in and in front of which, after clearing away the earth, I detected a pair of feet carved in the rock. They were badly mutilated but still showed traces of the toes and portions of the sandals. These feet had originally formed part of a complete figure, and the fragment of head found on the floor had belonged to it.

Another pair of feet at the right, still more completely obliterated, indicated the position of a second figure. The fragment shown in Fig. 2 lies on the floor at *a*, Fig. 3, and doubtless originally occupied nearly the position in the wall indicated in the sketch. These figures had been wedged or blown off and broken up by the Spaniards, and the whole shrine dismantled. There are other recesses of similar character in this hill, which show like treatment by the conquerors or their descendants. One at the opposite end of the crest, near the terminus of the great causeway, is said to have had a calendar carved in the living rock of the rear wall, a spot now exhibiting a deep irregular excavation thought to have been made by treasure hunters.[1]

In this connection it is convenient to mention a remarkable piece of work, a block of curiously carved andesite that rests upon the outer extremity of the crest of the hill. Although in such a prominent place it is partially obscured by trees of copal, etc., and would escape the attention of the casual observer; besides, the sledge of the destroyer has obliterated much of the evidence of art. In order to preserve a memorandum of the work, I stood upon a contiguous rock and made the sketch presented in Fig. 4, my line of vision being at an angle of 45° with the flat surface of the stone, *c c*, which is horizontally placed.

The surface has been cut down, leveled and finished with a pointed implement, leaving a pecked or granular surface, while the middle portion of the rock was left in relief and carved into the curious form indicated in the sketch, but which has been almost completely obliterated by the hammer of the despoiler.

The query arises, what has this rock been, and what its function, that the godly missionaries should have endeavored to destroy it?

[1] For details see Bancroft's Native Races and works cited by him.

I was struck at first sight, although without previous thought of the matter, that here was a stone perfectly suited for the offering of human sacrifice. I could readily imagine the feet of the victim placed upon the step *b*, while his back rested upon the highest level, *a*, giving the ideal position assumed in the pictures in the blood-curdling narratives of the conquerors. The level spaces, *c c*, would afford a perfectly convenient support for the feet of the officiating priests.

By inverting the picture it will be seen that the part of the figure most effectually destroyed by the hammer of the iconoclast has an outline suggestive of the upper part of a human figure, so

FIG. 4.—Sculptured rock on the summit of the hill of Texcocingo.

that it is not impossible that this stone was really the figure of some deity, partly finished, perhaps, as the step-like portion representing the knees of the supposed figure is entirely without suggestions of the limbs.

The prostrate position rather tends to discredit this theory, as such figures are usually carved in place, the mass being too great to be easily adjusted to an upright position. The length of this figure and of the block is about eleven feet. A contiguous block of stone, *d*, although apparently never a part of it, is also cut down to the same level as *c c*, indicating the intention to make use of the surface in its present position. It is perfectly natural that one should feel a desire to identify one of the sacri-

ficial stones of the Aztecs. I present this instance as at least a plausible case.

The Texcocan monarch is said to have climbed the 500 steps that led to the summit to worship an idol that stood there, and it is said that this idol, hewn from the living rock, was the image of a coyote, the emblem of Nezahualcoyotl, the King.

Since, however, human sacrifice is acknowledged to have been extensively practiced by these people, it strikes me that in no other locality could we more readily expect to find the material evidence of the existence of such a practice as on the summit of this wonderful hill, a point which overlooked the whole valley of Mexico, and which seems to have been almost wholly devoted to the service of the gods.

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THE PRESENT CONDITION OF THE YELLOWSTONE NATIONAL PARK.

BY E. D. COPE.

TIME has fully justified the enterprise of Dr. Hayden in urging upon Congress the project of the creation of the Yellowstone National Park; and the protection of this and other especially interesting parts of our country by the arm of the National Government has met with almost unanimous approval.

The function of the Yellowstone Park may be looked on as three-fold: first, as a place of permanent preservation of the geysers and hot springs and their deposits; second, as a place of protection of the game of the country; and third, as a place of recreation for tourists. The first of these uses has always been uppermost. The second has been more and more engaging the attention of Congress, and the NATURALIST published an editorial in its issue of July, 1884, pressing on public attention the necessity of making it a more complete preserve for game than it had previously been. This article was reprinted; and later, our contemporary, *Science*, took up the subject editorially. As a probable consequence of this agitation a bill was introduced into Congress, last winter, providing for a more complete supervision of the territory of the park. Ten men with a gamekeeper and the superintendent, constitute the present force. As this was manifestly insufficient to police a territory of such great extent, the new bill contemplated the addition of fifteen men to the num-

ber, thus increasing the police to twenty-five men. Their salaries were fixed by the new bill at $1500 per annum. The sum now paid is $900, from which the men are expected to feed themselves, an important consideration in so expensive a region. This bill was not passed.

Since the attention of Congress and of the press has been directed to the park, the protection of its beauties and curiosities has been more efficient. A number of persons have been fined for breaking the geyser deposits, including at least one member of Congress. In this respect the protection may be considered to be now fairly good. Protection of game has been less successful because more difficult, and because of the great inadequacy of the force. Bison, elk, moose, deer, etc., are far less abundant than when the park was first created. The bison have been, I am informed, reduced to a herd of about sixty individuals, and the elk have been decimated. The moose are confined to a small region. From the inaccessible nature of their habitat, mountain sheep have not been so reduced in numbers. Protection has, however, become more definite in this direction. During the past year several persons have been fined from $75 to $100, and one old hunter, who defied the guards, was caught, fined $100, and imprisoned for six months.

These measures of protection can, however, only be carried into effect by an increase in the force and their proper distribution throughout the territory. Persons may now hunt undetected in the park, and may drive game outside of its boundaries without difficulty and kill it. The disposition to kill is not controlled by any considerations of decency in some men. Thus a party of English shooters killed, for their amusement, twenty or thirty from the bison herd without taking any part of the animals for their use, thus reducing their numbers by one-fourth at least, at one battue. Some persons state that protection is useless because the game leaves the park in winter. This I ascertained is not true, for there are numerous well-protected localities where the game winter safely.

The bill which was brought before Congress last winter for the more efficient protection of the park should be passed by the Congress of 1885–6, with some possible amendments. Thus the force should be increased to twenty-five men, each with a salary of $1000 per annum exclusive of his food and boarding. The

park should be divided into twenty-five parts, each one supervised by one of the guards with perhaps an assistant or roustabout. A simple house for the guard should be erected in each one of the divisions, and the guard should reside there through both winter and summer, and not be permitted, as is now the case, to come into the settlements and remain there during the winter. It is well known that large game may be more readily destroyed in winter than in summer. Those guards whose districts include the geysers will naturally be more occupied with the protection of these objects than the protection of the game, as the one is generally abundant inversely to the other. Visitors should not be permitted to carry guns or other hunting apparatus through the park, and should be required to deposit them with some designated person to be held during their stay in it.

A project for reducing the size of the park has already been introduced into Congress. This is in order to permit the construction of a railroad to the Clark's Fork mining camp, through the park via the Yellowstone, the East Fork, and Soda Butte creek. As the law creating the park forbids the passage of railroads through it, it is sought to alienate a tract of land from the park, of a triangular shape, of about forty miles in length and twelve to fifteen miles wide at the widest part. An examination of the map will show that the direct route from the Clark's Fork mines to the Northern Pacific railroad is not more than *one-tenth* as long as the one proposed to pass through the park, so that it is difficult to guess at the motive which prompts the proposition in view. The project should be subjected to the most rigid examination, as any alienation of the territory of the park seems to be unnecessary. On the other hand much greater security as a game preserve would be accomplished if the region on the south-east border of the park, which includes the Hoodoo mountains, were annexed to it. It is the headquarters of the game of the country, and that of the park frequently resorts to it. It is excessively rugged, and is nearly useless to man for any other purpose.

As regards the entertainment of tourists, the administration of the new superintendent, Mr. Weare, has been a great improvement over that of his predecessor. The monopoly of transportation, sought to be established, has been abolished, and competition is free to guides and hotel-keepers. This naturally has the

effect of reducing rates, and will do so still more, for the charges have not yet reached bed-rock. When this desirable result has been achieved, the Yellowstone National Park will become one of the most popular resorts for tourists of all nations, who will be amply repaid by an inspection of one of the few remaining regions of the earth where thermal activity still reaches its surface, and of the grand and impressive scenery which surrounds it.

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AN OBSERVATION ON THE HYBRIDIZATION AND CROSS-BREEDING OF PLANTS.[1]

BY E. LEWIS STURTEVANT, M.D.

GEORG von Martens, in his Gartenbohnen, Ravensburg, 1869, p. 35, under Phaseolus Pardus virescens, the graugrune pantherbohne, says: "I was very much surprised to obtain not less than eight varieties of beans, die incarnatbohne, die dottergelbebohne, die weissebohne, die amethystfarbige zebrabohne, die graugrune pantherbohne, die helle pantherbohne, die gelbgefleckte pantherbohne, and the princessinbohne. With more thorough investigation I decided that the zebrabohne was most likely a neighbor which had overrun the bed, but all the others came from the bed, and some, the incarnatbohne and the weissebohne had not been planted in the whole garden." Martens might have expressed surprise that these varieties from the seed of the graugrune pantherbohne were all towards named varieties rather than sports or intermediates, but this fact, which frequently appears noted in his book, does not receive attention as being of any importance.

At the New York Agricultural Experiment Station, in 1882, a few oblong beans, slightly flattened sidewise and mottled in two shades of brown, were selected from the yield of the golden cranberry. This selection, planted by itself in 1883, gave eleven distinct forms, many of which can be referred to named varieties, and possibly with a greater acquaintance with varieties all might be so referred; an illustration confirmatory of the results above noted by Martens, and is strengthened by a list of similar occurrences with other varieties in 1883 numbering a score.

This fact of named varieties being produced from seed of other varieties is not confined to the bean family alone. The following

[1] Read before section F, A. A. A. S. at the Ann Arbor meeting.

list includes similar occurrences noted at the New York Agricultural Experiment Station during the last three years:

Maize.—Seed of one kind sown often produces samples of other kinds of corn in the crop, and these varieties can usually be distinctly referred by name to varieties with which the original seed might have been crossed. Purposely hybridized seed has produced the original parentage without intermediate types, and seed exposed to hybridization during two years with many sorts of corn, has yielded ears of the types of corn with which cross-breeding or hybridization has been effected, without appearance of intermediate forms.

Barley.—April, 1884, one head of cross-bred awnless barley was received from Mr. Horsford, a seed-grower in Vermont. The yield of the twenty-six seed was four distinct sorts of barley; one beardless black, one beardless white, one bearded black and one bearded white. One peculiarity was, that the beardless forms could be referred to *Hordeum trifurcatum.* There were no intermediates in this crop.

Peppers.—In 1882 eleven varieties of peppers were grown; in 1883, nineteen varieties. The pepper plant is extremely variable. The fruit on different plants of the same variety often varies much in shape; on some the fruit is borne erect, on others pendant; certain plants of a variety often mature their fruit much earlier than do others. These facts, as well as direct observation, certify to the ready cross-fertilization between varieties. Yet despite this apparent cross-fertilization, varieties by selection are kept true to name, and almost all or perhaps all of the various "sporting" forms noted by us are found illustrated in Hortus Eystettensis, 1613, a fact which brings the pepper in line with our other illustrations.

Tomato.[1]—In 1882 the French upright tomato was crossed with

[1] Some additional observations of a later date than those given in this paper are as follows:

Melon.—The Christiana melon seed used in 1885 was from two sources. The one seed pure and the crop all on type; the other seed station-grown in 1883 and subjected to a possible cross-fertilization with other varieties; the produce from this seed gave this year fruit mostly of pure Christiana type, but some plants yielded fruit of the early white Japan, long Persian and Hackensack types, and no intermediates. These off-varieties were among the melon varieties of 1883, and by which there was a possibility of the Christiana being crossed through insect agency.

Tomato.—In 1883 the French upright tomato was crossed by the Livingston's favorite, and the crossed seed has been attempted to be grown in purity up to date.

pollen from the alpha and Livingston's favorite. The produce from the cross-breds was one plant of the French upright, a hundred or more of the common form, and no intermediates. The fruit was all clustered, however, and of one type of bearing. The types of the tomato fruit have not as yet been sufficiently studied by us to allow of a judgment upon variability in this respect.

Squash. — In 1883 the perfect gem and vegetable marrow squashes were crossed in both directions. The seed planted in 1884 gave good types of the cocoanut, green-striped bergen and the courge d'Italie varieties. In 1883, the year the seed was saved, we had no plants of these varieties upon the station grounds. There were also some unknown forms, but none that could be called strictly intermediate between the varieties, and some which represented each parentage.

Lettuce.—In 1883 the green fringed and the deer tongue lettuce was crossed. In 1884 the crop yielded forms which could be referred to the Batavian, Silesian and Malta drumhead varieties,

This year is hence the second generation from the cross. The number of plants under observation have been numerous, occupying three-twentieths of an acre. The types of the plants are French upright and the common, without intermediate forms. The types of the fruit are French upright, Livingston's favorite, common red and great Chihuahua, and no intermediates that can be recognized. The last-named is precisely on type both in plant and fruit, but few plants as compared with the others.

French upright crossed by acme. First generation. The types of plant either French upright or acme. The fruit acme, French upright and common red, and no intermediates.

French upright crossed by alpha. Second generation. The type of plant both kinds. The French upright type of plants have all French upright type of fruit. The common type of plants bear fruit of the fig, pear, plum, alpha, common red, French upright and great Chihuahua type, and no intermediates that can be recognized.

Currant crossed by Livingston's favorite. First generation. The types of plant mostly the currant, but some few plants of the common form, but slightly more upright. The fruit is racemed like the currant, but of far larger size, about 1⅛ inch in diameter. Although I have never seen fruit of this character before, yet the plant and the fruit correspond very closely with the description of the Solanum racemosum cerasorum forma of Bauhin's Prodromus, ed. of 1671, p. 90; and we may legitimately suspect atavism has reproduced this apparently lost variety.

Turks cap crossed by several large varieties in 1882, such as acme, trophy, mayflower and paragon. The first generation was grown in the greenhouse, and hence the crop of 1885 is the fourth generation, the selections having been made each year for soundness and smoothness of fruit. The foliage of the 1885 plants somewhat variable but of the common type. The fruit can be referred to the apple, acme and common red. One plat from the earliest seed of this class has given constant foliage, and the fruit small, of the plum variety type, and of constant form.

and there were no intermediates between the parents. In this case we had the parents of two very distinct types, there being scarcely a point of resemblance in general appearance.

Pea.—In 1883 we had crosses between the sugar pea and the common pea. The 1884 crop from the crossed seed had the seed all of the sugar pea type, the pods all of the common type. The wrinkled pea crossed with the smooth pea gave wrinkled and smooth peas in the same pod, but no merging of the two forms.

These facts of careful observation and record are only explainable by the hypothesis that in certain kinds of cross-fertilizations and hybridizations the tendency of the crossed seed is to reproduce ancestral forms rather than intermediate forms. That there can be a blending of characters in certain cases is well known or certainly well asserted; but in the experience gained at the New York Agricultural Experiment Station, "sports" or blendings are rare in exact accordance with our familiarity with varieties. Thus in the case of the maize, at first we had many cases noted in our collection as variables; with the increase of varieties grown, and with increased specimens in our museum collection, these variables, almost without exception, could be referred to types or varieties, and the few exceptions to this statement occur in the little-studied class of pod or husk corns. Two illustrations will suffice: in New Jersey an excellent farmer there noticed a few pod ears in his crop of Blount's prolific dent and forwarded samples to the station as novelties. The seed from these pod ears reproduced with us Blount's prolific of perfect type and pod corn of the same type of ear which furnished the seed, and no variables from the two types noted. From the crossing of pod corn with sweet corn a new variety of sweet corn was produced, of a distinct type and esteemed by us a novelty in every respect, the cob being fusiform, the kernels horse tooth and much wrinkled, the stalk very small. At a later date this type appeared in our collections as the banana sugar, and was proven not to be original with us.

Darwin, in his Animals and Plants under Domestication, the New York edition of 1868, Vol. II, p. 54, has a section entitled, "Crossing as a direct cause of Reversion," and says: "But that the act of crossing in itself gives an impulse toward reversion, as shown by the reäppearance of long-lost characters, has never, I believe, been hitherto proved." His line of evidence, however,

is different from that here presented, and embraces a different series of observations.

The lack of agricultural museums in which domesticated varieties of plants find representation, the general ignorance of the varieties which were grown by our predecessors, and the in general careless descriptions which occur in the writings on agriculture, render a study of this sort embarrassing and difficult. A careful study, however, of the figures given by the botanists of the sixteenth century and thereafter, and a careful collation of evidence gleaned from more recent authors on gardening, together with the fact that the appearance of new form-species of cultivated vegetables seems to date from the introduction of forms of the same species from distant regions, and the rarity of appearance of novelties which cannot be identified with some previously described type,[1] all encourage to the belief in the correctness of the generalization that in our domesticated vegetable plants cross-fertilization shows its effect at once in the reproduction of the form-species and varieties which are involved in the parentage of the crossed seed, and that when "pure seed" is crossed intermediate forms rarely occur, but the original parents in variable proportions.

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OBSERVATIONS ON THE MUSKRAT.[2]

BY AMOS W. BUTLER.

THE muskrat (*Fiber zibethicus* Cuv.) is very abundant in most localities in Southeastern Indiana. In local distribution it varies in numbers according to the abundance of water and favorable localities for its increase. From all that I can learn, I do not think it is less common than at the time of the early settlement of this region.

These animals soon became acquainted with man and, from experience, learned that his presence assured them a great abundance of food at much less labor than formerly, while, at the same time, their natural enemies decreased in numbers on account of his necessity and pleasure. In some localities, owing to the perse-

[1] For instance, the deer tongue lettuce, with lanceolate leaves, which appeared about 1883, is almost identical with the Lactuca folio oblongo acuto figured in Bauhin's Prodromas, edition of 1671, p. 60.

[2] Read before the section of Biology of the American Association for the Advancement of Science at Ann Arbor, Mich., Aug. 27, 1885.

cution of a neighborhood of farmers, muskrats are few in numbers and are very shy. In the greater number of places, however, but little attention is paid to their destruction, and in consequence they become very tame, being found within the corporate limits of some of our larger towns. Originally they had their home in the neighborhood of natural water-courses, but with the system of State improvements which led to the building of our canals, there came, in many localities, a change in the life of the muskrats. Upon the completion of "The White Water Valley Canal," in 1846, the greater number of muskrats living upon the streams along which it ran, sought this artificial water-way and there established homes. No doubt they soon realized the greater security this canal afforded them from the frequent floods and from other dangers they had formerly experienced. At the present time, along that portion of the canal in existence, but few muskrats have sought the neighboring streams whence their ancestors came. When the muskrats changed their residence to the line of the canal they made new homes in its loamy banks, similar to the ones they had deserted along the river side. They are found both in our water-power canal and in the swifter streams, most numerous where there is a good food supply and at the same time near by a quiet nook secluded from the prying eyes of some human enemy and his allies. I have noticed them to be exceedingly abundant about the estuaries of creeks whose banks are covered with a luxuriant growth of vegetation.

When the canal through this part of the State was destroyed in 1866, the rats disappeared from many places where they had long found a home. Some sought the river where their ancestors had dug their holes in times long past; others gathered into certain parts of the old canal bed which were not permitted to remain unused. One of these portions is now the property of "The Brookville and Metamora Hydraulic Company," and is used for the purpose of supplying power to several mills along its banks. This part of the old canal is about fifteen miles long, extending from Laurel to Brookville. It is here that I have become best acquainted with this water-loving rodent.

The muskrat prefers its home in banks of loam or light clay, especially when heavily covered by vegetation. It is very exceptional that it occupies gravelly or sandy banks. Advantage has been taken of this fact by the managers of our water-way and

by the railroad company. Where they have constructed gravel banks and kept them free from vegetable growth, it is rarely they are bothered. Trenching the banks and filling in the trenches with gravel has proved of considerable value, while some protection has been afforded by a top-dressing of coarse gravel over an old bank of loam, provided vegetation is not allowed to grow thereon. When these precautions have not been taken, great damage is done each year; the burrows of these animals are continually being enlarged, and caving in, cause a leak, or undermine the railroad track, as the case may be.

In early spring the greatest damage is done. With the alternate freezing and thawing at that time of the year, the coverings of these underground passages drop in, exposing cavities of surprising extent to one who does not know the amount of subterranean work this animal is capable of doing. It requires vigilant work of eyes and ears to prevent this caving causing great damage to property. The underground homes of the muskrat in the banks of the canal have each two openings. When the water is at its usual stage an opening may be found, the upper edge of which is on a level with the surface of the water; another hole may be seen at low-water mark, the top of which is just level with the surface of the water at that stage. These holes are generally from eighteen inches to two feet apart. The passages from these openings lead backward and upward in a very crooked way, as any one who has attempted to follow them up can testify. These passages end in a large gallery which is the home of the animal. From this chamber a small passage leads to the surface, ending amid a bunch of grass or weeds. By this means the gallery is ventilated. The holes at the surface are known as "air holes." They are not always found, at least I have not in all instances observed them. In heavy ground an "air hole" is always found, while in porous ground it is as often absent as not. These underground burrows extend into the bank a distance of ten to twenty feet in a straight line, as a rule. Instances have been noted where the depth reached was less than the minimum given above, but such are rare. In localities along small streams which are subject to sudden rises, the distance attained occasionally reaches thirty feet, but in all instances the depth to which these burrows reach depends, in a great measure, upon the size and composition of a bank as well as upon the liability of the neighboring stream to sudden changes of level.

In the abandoned parts of the old canal before referred to, the muskrat built houses for the first time in this part of the State. They were few in number, and were confined to wet tracts, the source of whose water supply was springs from the neighboring Silurian hills, or in swamps adjacent to the line of the canal. Until within the past three years no houses had been built along the water-power canal between Brookville and Laurel. Each succeeding year I noticed the erection of a few more houses, until at this time there are a dozen or more within the fifteen miles just mentioned. Within ten miles of the northern end of this artificial water-way, in the old bed of the canal, have been several houses for a number of years. Whether this house-building habit is caused by some of the house-building muskrats coming from up the stream, or whether, from some unknown reason, the animals of our own locality have thus taken upon themselves this much of the ways of some distant ancestor, we cannot say. That muskrats do, from force of circumstances, change their location, is a well-known fact, and such a change would perhaps be the most logical way to account for the recent house-building just mentioned.

I have made careful examination of some of these houses, and herewith present some extracts from my notes on one of them which I consider typical in construction and arrangement. The examination of this house was made in January last when the ground was frozen, but the more rapid streams had little or no ice upon them. This particular house was built upon the highest part of a piece of marshy ground on a peninsula extending into a stream which passed through the marsh. The end of the peninsula had been dug off to the level of the bottom of the stream, leaving a semicircular exposure of land. A part of the base of the house followed the configuration of the edge of this excavation, while the remainder of the foundation rested upon the bottom of the stream. In consequence of this rather more than half of the house adjoined the water. The house was composed chiefly of swamp grass, sedge, coarse weeds and mud, while fresh-water algæ, small pieces of drift, a few pieces of shingles and two staves were found among the more common material. The greater part of the mud was in the lower part of the house, and I think was mostly brought in attached to the roots of grass. The ground in the neighborhood of this house was cleared of all

vegetation, even of the roots, for some distance. The house was thatched very nicely with weeds and sedge. The ground plan was oval in outline, four feet six inches wide and six feet three inches long. On the land side the house was two feet six inches high, and on the water side three feet four inches. The whole presented the appearance, in miniature, of an oblong hay rick. The inside was quite irregular. Measurements at the bottom of the chamber showed the greatest length to be twenty-two inches, the least sixteen inches, with an average width of twelve inches. The greatest height, measuring from the bottom of the stream, was one foot. Six inches from the bottom a shelf was found running from the left of the entrance and above the top of the water. This shelf was twelve inches long and eight inches wide, and ranged from six to eight inches in height. It was arched over very neatly with drift and coarse weeds. At a point farthest from the center of the chamber, immediately over the shelf, was a passage leading upwards toward the side of the house. While it did not penetrate the wall, it passed through the more compact portion and enabled the inmates to obtain air. Entrance was had through a covered way from and beneath the water without to the center of the house, where it terminated in a mass of fine grass and mud, through which was a funnel-shaped opening to the interior. This house was completely destroyed; within a week after its destruction the muskrats had erected a new home upon the site of the old one. In securing material for this they had used the remains of the ruined house, and had cleared a much larger space of ground of its withered vegetation. In outline the new house resembled the old one very much, but it was of nearly double the size of the ruined structure. There are peculiarities in the shape of many houses, but that which I have described appears typical in form and in interior arrangement of these structures in this vicinity. Some of these houses are built at a time when the water is low, and as the fall rains swell the streams the rats are compelled to ,reconstruct their buildings, raising the top above the highest level of the water. I knew a muskrat to try this plan last year. It built its house within the banks of an ice-pond which was almost dry; as the water was turned on, late in the fall, the owner tried, by making the house higher, to keep a portion of the structure above the encroaching water. An increase in altitude of six feet was too much for the

industrious animal; by the time half this height was reached he gave up the work. Occasionally instead of laying a part of the foundation out of the water, the house is begun entirely within the water. At times I have known a hollow stump, which had a lower opening beneath the water, to be used. The stump being covered over and some grass and other material placed around the base, it required close observation to recognize the framework of the structure. I have known these animals to take possession of a barrel which stood on its end in the water, and after covering it over so as to almost hide it, to give up the work and erect a dwelling without the substantial assistance such an article would afford.

I find the muskrat lives, the greater part of the year, in its sinuous galleries in the banks of our streams. Each autumn new houses are built or old ones repaired, but these are only occupied when the surrounding streams are locked in a sheet of ice. At such times it is by no means uncommon to find several representatives of the species living in harmony within one of these winter homes. I am convinced that in this vicinity one brood of muskrats is regularly brought forth each year. There are, in all probability, occasional exceptions to this rule, when perhaps two and even three broods are born. Mating takes place late in February or early in March, depending upon the condition of the weather, and continues about three weeks. This year these animals were first noted as mating on March 10th. At this season the female utters a hoarse squeal by which the males are attracted. The period of gestation is about six weeks. In April or early May the young are brought forth; from four to six helpless and hairless little creatures may then be found by the persevering investigator far within the subterranean home within a nest of grass and other soft vegetable growth. The young remain in the nest until they are about half grown, unless their home be flooded, when they often perish, but in some instances are rescued by the mother. Mr. E. R. Quick relates one instance when, during a flood July 3d, 1873, he saw a female muskrat swimming along in the muddy water with five young, about the size of a full-grown house rat, holding on to tufts of the mother's hair with their mouths, while she made her way slowly and cautiously along the shore; carefully she avoided all obstructions and swift water, seeking a shelter for her precious tow. Some boyish enemy, per-

ceiving the homeless family, threw a stone which struck the mother and scattered the young. The latter apparently knew nothing of diving and but little of swimming; with difficulty they gained the shore, and while seeking the protection of some reeds a part of them were caught. I have never found the young caring for themselves until after the beginning of July. In September, a few years since, a litter of young was taken from a nest in the canal bank. They were not over one-third grown. This record I have always considered as referring to a second or perhaps a third brood, and is my only note that would indicate a plurality of broods.

During the rutting season the grunts of the males answer the squealing of the females, the noise of scuffles between the males, the continuous splashing made by the animals in the water fill the air, in the vicinity of one of their favorite ponds, with sounds which would surprise one who was not familiar with the neighborhood of a muskrat's home, on a warm night in early spring. At this time of the year they are seen during daylight more than at any other, sometimes even deigning to show their love-making to inquiring eyes.

Muskrats are naturally herbivorous. They feed upon land and water plants alike, in some instances using roots, stems and fruit. They are noted enemies of the "bottom" farmer. In his fields it is that corn grows most plentifully, and upon this cereal muskrats love to feed. They eat corn at any time after it is planted, taking the seed from the ground or the young plant from the furrow. The greatest damage is done after the ear is well formed. "Roasting ears" appear to be a favorite article of food with them. From this time until the corn is gathered, nightly visits are made to the nighboring cornfield, where the stalks are cut down and sometimes carried to their homes, but more frequently the juicy ear is the only part taken. At times streams near cornfields seem covered with floating stalks, the result of the muskrat's nocturnal forays. As the corn becomes hard it is frequently a difficult question for them to tell how they will get the grains off the cob as easily as formerly. They evidently master the question in some instances, for I have known them to deposit the flinty ears in a stream for two or three days until the grains become soft, when they could be readily removed. It seems strange that an animal having teeth of the cutting power those of the muskrat possess,

should seek to do this, but in all probability the teeth, from continued eating of vegetable food throughout the summer, become tender and are unable to cut hard grains of corn with ease. This is the case with many domestic animals in autumn when fed on corn after some months of pasture life. Muskrats are very fond of parsnips, turnips and apples. They frequent apple orchards and turnip patches, near their homes, and make use of much of the farmer's abundant crop of these articles. When snow, which had lain on the ground for some time, melted, I have observed that plats of grass near the water's edge had been eaten bare by these animals while they were confined to such diet as they could find beneath the ice. Their food is not entirely vegetable; in winter and in early spring they subsist, in a great part, upon the flesh of river mussels. Many a winter morning have I found a number of well cleaned shells of the more delicate mussels upon the ice near swift, running water. I have never been able to satisfy myself that this food was used by them at any other time of the year. Neither do I believe that this material was originally so used. It is very probable that owing to the scarcity of suitable vegetable food, they have been forced to include the meat of the mussel among their articles of diet; largely on account of its abundance near their watery haunts and also on account of the ease with which it is obtained. Such change of food has not occurred in this region within historic time, perhaps, but it is evident that formerly, when there were few mussels in these rivers, not so many of them were eaten. With the conditions favorable to their development produced by our canal, mussels multiplied very rapidly, and in proportion to their increase in numbers the muskrat increased his mussel-eating. Records of this are preserved in the banks of the canal; alternate deposits of shells, cleaned by the muskrat, and of sediment may be seen in many localities reaching to the depth of two feet below the present bed of the stream. Upon these same piles of bivalve remains the muskrat leaves the remains of most of the mussels it eats. I have never known the muskrat to eat univalve mollusks. I have identified the following shells as forming the principal part of its bivalve food in this vicinity: *Anodonta plana* Lea, *A. decora* Lea, *A. imbecillus* Say, *Unio luteolus* Lam., *U. parvus* Barnes, *Margaritana rugosa* Lea, and *M. complanata* Lea; all common in proportion to their comparative abundance. In some localities I

found the young of *Unio occidens* Lea, but not very common. In another locality where *Unio lachrymosus* Lea is the prevailing species, I found its shells forming the bulk of the refuse near muskrat homes. In this same locality I found examples of *Unio plicatus* LeS. and *U. multiplicatus* Lea, but they were not common. The young of heavier shells are to be found as commonly, in proportion to their abundance in the adjacent water, as are the remains of the more fragile species. I have estimated that about one-half the mollusks eaten are of the three species of Anodonta. I was surprised at the comparative abundance of the remains of *Margaritana rugosa* Lea in these piles of shells. This species is considered to be rather rare, but their shells are found as frequently there as are those of some of our more common species. From this fact I think the muskrat prefers the flesh of this species to that of others which might be more easily taken. I have, at times, found examples of living Unios among these heaps of shells; whether these had been brought there by the rats, or whether they had sought, of their own accord, a dwelling place among the remains of their dead ancestors I cannot say. The means by which the muskrat secures the body of a mussel has been frequently discussed of late. I think, from my observations, there are three ways in which these shells are opened. With many species I notice that the foot is very slowly withdrawn within the covering when the shell is handled. When such shells are taken it is very easy for the muskrat to insert its paws or long teeth between the valves and tear them asunder. The remains of some species show evidence of the cutting power of their enemy's teeth, the edges are broken; when this is done it would be very easy for the muskrat to find a sufficient opening to secure the animal as in the preceding instance. By those two ways the more fragile shells may be opened; the heavier species which are occasionally found, nicely cleaned, about the opening of the muskrat's home, could not be opened in this manner. I have on several occasions noticed these larger mussels lying on the bank of a stream near a muskrat hole, and within a few days they disappeared. The only way in which I can see the muskrat could obtain the body of one of these larger mollusks is by leaving the animal out of the water until it becomes weak or until it dies, when the valves could be easily separated. Muskrats at times eat of the bodies of dead animals. The remains of ducks, geese,

chickens, fish, and even in one instance a turtle, have been noted as forming a part of their food. The farmers of the lowlands ascribe to the muskrat a love for young ducks, but I think the greater part of their loss in this particular is referable to turtles.

The muskrat is largely nocturnal in its habits. On cloudy days and occasionally late in the afternoon one may be seen, along some quiet stretch of water, seeking food or looking for its mate. It is not much at ease on land, although when pursued it moves over the ground at an ambling gait with some degree of rapidity. It is an expert at swimming and diving. Before diving it appears to inflate its lungs with air, and when it disappears remains beneath the water for some time, the course it takes being frequently traceable by rising bubbles of air. When surprised it plunges into the water suddenly without the necessary supply of air, and is forced to come to the surface in a very short time. When frightened it generally seeks its hole, but such is not always the case. In open water it dives to a considerable depth, and I have noticed it passing through shallow water apparently running upon the bottom. Under the ice it may be noticed, at times, swimming quite close to the surface of the water. It appears disinclined to dive in muddy water. Upon several occasions, when our streams have been swollen, I have attempted to make one dive by stoning it, but generally without success; sometimes it would dive, but would almost immediately reappear. When our water-courses are covered with ice the muskrat has regular places of egress and ingress, such places being where, owing to swift water, ice had not formed, or where the ice along the banks of a stream had become broken.

Several methods are employed to capture or to kill muskrats. Many of them are caught by means of steel traps. They are very unsuspicious and regularly become the victims of their self-assurance. A dead fall is frequently used with some effect. It is generally placed over a well-worn runway leading to a favorite feeding ground. Many muskrats are killed by means of poisoned apples or turnips which are placed in the neighborhood of their burrows. The latter plan is often tried by the farmers of our uplands to kill these animals when they become too numerous in the ditches and smaller streams. A method used with great success by a local water-power company, in winter, is as follows: A barrel with both ends out is placed upright near the bank with

about half its length in the water. Upon the water inside the barrel is placed grass and weeds, and on this foundation the bait, generally a few pieces of parsnip, is put. In a few days the animals will become familiar with this new object, and thereafter the barrel may be visited regularly. After a warm night the trapper is reasonably sure of finding some game in his barrel. Sometimes he will find but one or two rats, but more frequently he will catch from three to six, and on one occasion I have known ten rats to be taken in one barrel in a single night. At mating time if a female be caught several males will be taken prisoners in the same barrel in their efforts to become her company. When a rat gets into the barrel it is impossible, owing to the depth of the water, for it to stand upon its hinder limbs to cut a hole in the staves above water line, and at the same time impossible for it to get out at the top of the barrel. When several are taken the same night a fight generally ensues, resulting in the death of all of the captives either by the sharp teeth of their companions or by drowning. I have known instances where several of these rats had been captured and killed, but the trapper did not visit his traps for some time; upon his arrival, however, he found but a few heads and bones to tell of the tragedy that had been enacted and of the feast which the other muskrats had when the water receded enough for them to enter and leave the barrel. This habit is not uncommon when more acceptable food is scarce. Last spring a muskrat was caught in a steel trap; when the trapper went to his trap next morning he found another rat eating the dead one; upon examination it was found the entire right shoulder had been eaten off. Spears are rarely used, but they are sometimes brought into service when the streams are ice bound to kill the inhabitants of a winter house. Many muskrats are shot in early spring when the ice breaks up.

Of the enemies of the muskrat man ranks first, and next to him the dog. Hawks and owls of the larger species, foxes and minks are all very destructive to this animal. The mink is perhaps it greatest natural enemy, but fortunately for it minks are rare. The remains of muskrats have, on several occasions, been found in the stomachs of large catfish, but the flavor of the food had been so thoroughly imparted to the meat of the fish that it was unfit to eat. The muskrat is at times very ferocious. When cornered by dogs or man it frequently shows fight, and if pressed too closely is able to do much execution with its sharp teeth.

Muskrats have their pleasures as do other animals, but as their favorite time for sport is after night, we have but little opportunity to become acquainted with them socially. On a warm quiet afternoon they appear to enjoy a sunning in some secluded spot. Their gambols in the water, of a quiet evening, remind me much of the playing of kittens. They may be seen at times, of a moonlight night, chasing each other over some sand bar near their watery home. On the whole a study of their enjoyments is very unsatisfactory, and much of our knowledge of the life history of these animals will be but slowly acquired.

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THE PROBLEM OF THE SOARING BIRD.

BY I. LANCASTER.

IT is now more than two years since I first made known the results of investigations on the methods of flight of the great soaring birds, carried on at intervals since 1850. The whooping cranes of the Northwest, performing their migrations on motionless wings, had at that early date fixed my attention, and my times of leisure down to 1876 were devoted to ransacking the scientific and literary world and to observing the birds in the act whenever it was possible to do so, that I might get an explanation of the phenomenon of more substantial character than mere guess-work. Plenty of assumed solutions were found scattered about. Such theologians as I consulted were confident that the question had reached its lowest terms when it was said that "God had created the birds to fly." Common-sense folks rejected the idea of fixed wings and held to a slow flapping that could not be seen, while the scientists were confident of upward slanting currents of air and various atmospheric disturbances which produced the result. Accounts of travelers as to the facts were hopelessly confused, with a single exception, that of Charles Darwin in his Naturalist's Voyage around the World. His solution of the matter, that of the surging head, was given provisionally.

I was not prepared to deny any of the solutions given and not more ready to admit them, being conscious of very much ignorance of the entire matter. Meanwhile my interest in the subject, constantly increasing, had, in 1876, overshadowed all others, and being disengaged from business, I devoted the ensuing five

years to the birds on the Gulf coast of South Florida, where the soaring varieties were found in abundance, fully intending to unravel the case before leaving it. The task was a hard one, and the final solution was found in a totally unexpected direction. The predominant feeling I have since experienced in regard to it is one of surprise—surprise that in this ceaselessly active age mechanical possibilities of the most important character could exist in the atmospheric spaces all about us, with many of the largest species of existing birds putting them in daily practice before our eyes, and we still remaining completely ignorant of them! I propose in this paper to present, first, a few of the most significant facts exhibited by the soaring birds; next, to offer an explanation of the phenomenon; and finally, to examine the bearing of what has been said on the problem of artificial air-navigation.

I mean by a "soaring bird" one which habitually travels the air on motionless wings. All birds flap their pinions at times, and many of the smaller kinds, such as rooks, kestrels, crows and gulls can maintain flight on fixed wings when the conditions are favorable. But I would never think of observing them for lessons in soaring. They are too light to average the inequalities in the air current, and there are frequently long intervals of active wings before the fixed conditions occur. The soaring varieties are at it all the time. The frigate birds live in the air night and day for a week at a time without touching a roost. Their congeners, the buzzards, spend the day in the same style. The various cranes common to the coast often spend hours resting in the air, while the gannet is an admirable soaring bird with a heavy body and relatively small expanse of wings.

When I speak of "fixed" or "motionless" wings the meaning is that no muscular power is used to either overcome weight or air resistance. It is not meant that the pinions are absolutely rigid, like a board, for they are moved to accomplish change both in shape and position. But they do precisely resemble a board so far as the exertion of motive power is concerned. For instance, if a bird floats in a wind of unvarying velocity over any fixed point on the earth, then if a board of the same shape and size and weight were put in its place, it would remain there just as the bird does, as long as the conditions were unchanged. If the bird slightly changed the shape or position of its surfaces so as to ver-

tically ascend indefinitely, the board would also ascend in the same way were it to be changed in a similar manner.

This is seen in the performances of what I have termed "effigies." They were surfaces of veneer or cardboard fastened to a frame and balanced by a weighted pendant. They would simulate the actions of "soaring" perfectly. I have made numbers of them. They would leave the hand and travel against the wind for as much as 500 yards, remaining up for fifteen minutes. They had no ability to automatically balance themselves in unsteady currents of air, but they were good illustrations of "soaring."

The first thing to be definitely ascertained was whether the wings of the soaring birds were in fact as motionless as they seemed. To determine this point demanded close inspection, and although the creatures were not fearful of man in that remote country, they preferred a distance of thirty to forty feet away. The captive bird was useless for any critical test. 'Tis true that a bird ten feet in alar dimensions, resting horizontally above one's head thirty feet away, with the clear sky as a background, could be pretty well examined; still a closer position was not only desirable but imperative, and a resort was had to the arts of mimicry with entire success. Procuring a few square yards of thin muslin fabric sufficient to completely envelope my person, it was covered with paint of the green and brown shades so as to resemble the tree tops of localities in the vicinity of either the breeding places or the roosts of the soaring birds, and barring the unpleasant sensation one has when engaged in the arts of gross deception, I had everything pretty much my own way. Some trouble was experienced in striking the happy mean of scaring the great creatures enough to keep them from alighting on my face, and still not frighten them away, as they were totally oblivious of my presence. Wing movements could now be studied in every conceivable position at leisure, endwise, sidewise, from above, from beneath, and at every sort of obliquity. The conclusions of observations made from the ground at thirty feet distance were confirmed from the tree-top stations at all distances, from twelve inches upwards. In the first Florida year, observations were made with good results about 150 times, during which all the varieties of soaring birds of 100 miles of coast line were viewed. The trees of the country are short and stunted, and

easily climbed, and a little search was rewarded by the discovery of thick sturdy tops in which a secure lodgment could be had. The birds abounded in prodigious numbers, thousands occupying a single roosting ground. Not only was it seen that there was no motion of the wing as a whole, but that there was none of the individual feathers. There was no tremor, no slow nor fast waving; the entire bird moved when the wing did. When the wing was flapped there was no doubt about it, and the flapping could be seen as far almost as the bird was visible. Both the "soaring" and flapping were discoverable when they occurred beyond any doubt whatever. To determine horizontality of the sea breezes of the coast, a radial arm, feathered and balanced level, was used. It is evident that somewhere in the interior of the peninsula there must be an upward trend of the meeting winds from the Atlantic and Gulf, but there is none discoverable on the western coast. The wind, twenty-five feet above tide, moves uniformly on level lines, and ten feet above the forest tree tops no upward flow can be found. The lantern of Egmont light, 150 feet high, at the entrance of Tampa bay, was frequently used for these atmospheric observations.

There is a wide range in the relation between weight of bird and wing surface in the different species. It varies from less than one, to more than two feet for each pound weight. Uniformly the longer the wing to a given weight the greater the power of translation possessed by the bird, the man-of-war hawks in this respect surpassing all others. Wide, short wings were coupled with heavy bodies, as in the gannets, and these exhibited slower but steadier flight. The heavier the bird the steadier and easier seemed its movements, and a hungry vulture, which was very shaky in the breeze, could ride serenely when gorged with carrion.

The only peculiarities discoverable in the atmospheric condition required for soaring, was that the wind in all cases should move against the bird. The maximum velocity of this meeting of bird and air is unknown to me. I have timed the flight of frigate birds through calm air on fixed wings at 100 miles per hour, and their velocity seems to depend on their wishes more than on any limitation of the powers of translation. The minimum speed, however, can be approximated. For the frigate bird it is about two miles per hour, three for the buzzards and five for the gannets. The heavier the bird the greater is the minimum velocity required, and a gorged vulture cannot range itself with a flock of hungry ones, which are sporting in their minimum, without repeatedly flapping its wings.

(*To be continued.*)

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 953, October number.)

VI. The Mental Organism.

WE have now to consider a question of very great importance, that of the relations of the mind and its energies to the universe of matter and energy without. A review of the conditions of mental energy leads to conclusions of much significance. These, however, can only be given very briefly, but we will endeavor to point out their leading features and show the direction in which they tend and the remote possibilities of mental development which they indicate.

In the lowest animals, in which psychical powers are yet very feebly developed, if they exist at all, the inflowing energy makes its way at once to the muscular or contractile regions, and motion takes place in response. The action of external nature upon the body is immediately followed by a reaction of the body upon external nature. Where this action and reaction are in harmony, the body is a well-adapted reflex organism. As already said, however, with every new condition in the action the reaction becomes general, and new special adaptation is only slowly gained. And where there exists the rudiment of a psychical organism every sensory action of a new character probably always disturbs its conditions, yields a conscious sensation and affects its motor relations. By a long continuance of this process the mental organism becomes greatly developed. Of the external energies which crowd into the body during this increase in sensory and mental powers a constantly smaller percentage goes directly to the muscles, and a larger percentage to the mind, into which they enter as organizing or otherwise affecting agencies. Thus the energies which are checked in their flow through the body are never lost, but are employed in building up a reservoir of energies within. Instead of producing an immediate and direct reaction upon outer nature, they now produce a retarded and indirect reaction. The condition of affairs is vitally changed by this new condition of the organism. The body is at first an instrument of external nature alone. It is set in motion by the energies of certain external substances, and exerts energy on other external substances. But in its advanced condition the force of the external

energies is mainly exerted upon a fixed region of the organism, in which they become definitely centered and organized. And this reservoir of energies in its turn reacts upon outer nature. Instead of a single agent of action, with the body for its instrument, we have now two agents, an internal and an external one, with the body for their instrument. The nervous organism serves as the channel of intercommunication between these two active agents. And the high-atomed chemical molecules of the nerve cells or terminations, whether those of the outer surface, the muscles or the cerebrum, serve as sources of intermediate energy, which add to the vigor of the slight motor impulses from without or from within. In this view the mind is as little a necessary constituent part of the body as is outer nature. The body can perform its ordinary duties without the mind or its organ, and needs it only for its extraordinary duties.

In its primary relation this new condition of the organism only acts as a check on the rapidity of motor reaction. The mental affections retain their original form, and their reaction, when it takes place, will be of the same character as the immediate reaction would have been. But the mental organism soon begins to act as an independent agent. From the conditions impressed on it, new conditions are produced. There is an internal reaction and new combination of the mental energies. Memories combine to form thoughts or ideas, and motor relations are gained within the mind which have no counterpart without. These, in their turn, react on outer nature and yield peculiar results, no longer in consonance with external conditions. The microcosm without has built up a microcosm within, with powers and conditions of its own, and the body now becomes the intermedium between two independent and dissimilar acting agents. These may act only within themselves, or they may act upon each other through the medium of the body, each producing special modifications in the condition of the other.

These general considerations lead to more special ones. What is the character of the impressions produced by external energy upon the mental organism? These external energies are yielded by the substances of external nature, and in some way represent the conditions of these substances. As such they enter the body and impress the mind. Though all sensations may be conveyed over the nerve fibers as vibratory impulses, yet there must be some

difference in the character of these vibrations with every new kind of sensation, since the mind receives a peculiar impression from every peculiar sensory impulse. The memories thus implanted in the mind represent to us the conditions which exist without us. This representation very possibly may not be an exact one. Possibly it is only analogically similar. But it is all we know of external nature, and although each impression may not truly reproduce the condition from which it arose, there can be no doubt that the relations between these impressions are correct. The picture must be correct as an analogical reproduction if not as an actual one. It must be borne in mind also that the impressions received indicate the motor conditions of external substances, and that they become motor conditions of the psychical substance, so that their exactness of representation may be much closer than is usually surmised.

The mental organism thus acts as a mirror, in which the universe becomes more or less fully reflected. Its memories are reproductions, more or less exact, of external conditions, and it exists as, in a partial measure, a counterpart of external nature. But it is much more than this. Its powers are not confined to the reception and storage of external energy and the reflective reproduction of the forms and forces which emitted these energies, but it has a reorganizing power of its own. Its energies combine and produce new conditions, which may or may not have a counterpart in external nature. If these new productions are the outcome of reason they may represent conditions or forces in nature which are not apparent to our senses, as, for instance, the attraction of gravitation, or the vibrations of heat and light. If they are the outcome of imagination they may represent conditions which do not exist in nature and which are new creations of the mind.

The vision of a cathedral, for example, gives us a mental impression which becomes persistent. The mind has henceforth among its stores the image or representation of the external compound of matter which we call cathedral. A picture or a description of a cathedral may produce the same image. Close observation gives minute knowledge of the constituent parts of this edifice, and reasoning yields what the senses cannot convey, a conception of the architectural principles involved and of the forces at work in binding the parts of this structure together

down to its very chemical atoms. Thus by sensation and reasoning the mind gains a very minute and complete image of the edifice, which it may review in part or in the whole, as it will. The building seems to be erected in the mind, by the ease with which it can be mentally taken apart and put together, and each of its parts called up as a separate and distinct image.

But the mental powers can go much further than this. They can make different combinations of the separate parts of such an edifice and work out different results of the principles of architecture, and thus produce a compound not existent in external nature. This is the work of the imaginative or constructive faculty. In both these cases we seem to have but varied combinations of the mental images or energies. But the new form of building thus mentally constructed need not be confined to the mind. It can be erected in outer nature by the aid of the hands, or of other minds and hands. Thus as the mind mirrors external nature, the external may be made to mirror the mind. After beholding the cathedral there exists an image in the mind corresponding to a condition of external nature. After erecting the new edifice there exists a form in external nature corresponding to an image or condition of the mind. Mind and nature act and react upon, and each molds and modifies the other. The illustration here given might be endlessly paralleled, since it represents the general character of all the mental operations.

Evidently, then, the process of development is two-fold. The mind is being developed under influences derived from without, and the outer world under influences derived from within the body. The mind and the universe are becoming counterparts of each other, the one in external matter, the other in that unknown substance which is the basis of mind. Thus every mind is becoming a partial counterpart of the universe. At first this mirroring of the universe is very slight and imperfect. The mirror is of minute surface and very clouded in texture. But with the growth of knowledge it widens and grows clearer, and a continually greater breadth of the universe is reflected within it. If developed to its utmost conceivable extent, it might take in the whole universe and constitute a reproduction, in its special and localized conditions, of all the conditions existing in the broad range of external nature. Like the monads of Leibnitz, each of which was conceived to mirror all others, and each from its own special

point of view, each mind might come to mirror all things, physical or mental, and each from its own special point of reflection. Such a duplication of the conditions of the universe would be the necessary result of the infinite expansion of the relations of the mind of man to external nature.

The mode in which the thought constituents of the mind present themselves to consciousness strongly point to the above conclusion. We seem to become conscious of the existence of a counterpart, within our minds, of the universe, so far as we have come into rapport with it. There lie the forms surrounding us, the trees, houses, plains, mountains, &c., down to their smallest details, and each in its appropriate relation, alike of force and of position, to the others. With extended knowledge we gain a mental picture of the whole earth, with its diversity of natural scenery, its continents and oceans, its empires, cities and inhabitants, human and brute. The geological conditions of its surface are similarly apparent to us, and the deeper regions, so far as we are aware of their conditions. The intermotions and connecting forces and principles of these objects also form part of the mental reproduction. None of us have ever seen the whole of this picture. It has been mainly conveyed to our minds as a reflection from images present to other minds. Yet if we wish to see the earth we have but to look into the depths of our minds, and there we behold it, with all its parts arranged in their due order and relation. The mental universe of man is far more extensive than this. It stretches downward to include the minutest forms. We can even perceive the excessively minute atoms going through their endless dance, and the vibrations of the ether as radiations of light and heat run swiftly through it. It stretches upward to include the mightiest forms, the revolving planets and shining suns, each with its peculiar motions and attractive vigor. To see all this we do not need to look around us. We have but to look into our minds, into which it has entered and organized itself. The whole or a part may be seen at will, often falsely perhaps, from imperfect conceptions, but there lies our visible universe as it appears to our eyes, has arisen through the exercise of our reason, or has come to us at second hand from the eyes and minds of others.

We may, for instance, call up the memory of a tree. If we compare this image with the visual image of an actual tree there

will be no apparent difference, except in the greater vividness and sharpness of the latter. And it is remarkable how new impressions of an object annex themselves to those previously received, and thus fill out the original image. Our first idea of the human body is a mere outline. To this are gradually added impressions of its distinctive surface parts, its internal organs, its tissues, circulation, &c., its motions, and its general principles of formation and physiological functions. Each of these falls into its proper relation with the others, building up a full ideal image of the body. But this image retains the character of a manikin. It can be taken apart at will, and each part considered separately from the rest. This essential peculiarity pertains to all ideal conceptions. They have none of the necessary coherence of natural organisms. The conception never becomes an indissoluble mental image. It may be anatomized, as the body may, but without need of the slow process of dissection.

As to the part taken by the different senses in building up this mental picture there are important distinctions. Some yield us impressions of form and some of quality. The senses of smell, taste and hearing simply advise us of certain qualities or conditions of external things. Touch and sight also yield impressions of quality, but of form as well. They acquaint us with the space extension of objects, and also with their space relations and motions. It appears strange how the mind can gain a permanent record of the motions of one body in relation to others. We can only comprehend it as a record of form relations with time extension, the sensory impression of a very rapidly succeeding series of pictures on the mind, in each of which the relation of position of objects is changed. On recalling to consciousness this series of pictures the idea of movement must arise with it, precisely as occurs in the optical toy where a series of gradually differing pictures are blended by rapid succession on a moving disk, and the figures made to appear as if in actual motion. The impression of a musical air on the mind is probably of analogous character to the above, a time succession of differing sensations.

The reason has much to do with the correctness of our impressions of form. The eye receives its picture as a flat one, and it must affect the mind as such. The blind restored to sight see landscapes as flat pictures. Touch is necessary to make sure of the solidity of objects. Yet the pictures on the retina of the eye

differ from those on canvas in the perfection of their perspective and of their arrangement of light and shade. The effect on the mind may be that which any picture that was absolutely perfect in these respects would produce on the eye.

If we continue to view the mind as a substantial organism, and its conditions as due to the motor relations of the parts of this organism, the mode of impression of a formal image on it may bear some relation to photography.

It may seem inexplicable that the same nerve fiber in conveying currents of energy can yield such different impressions as these currents vary in their source. It might be argued that such currents could only differ in degree and not in kind. And yet the eye receives its pictures from currents of energy conveyed through a single medium, that of the vibrating ether. The variations in light and shade, color, &c., are due to variations in the conditions of this energy, and similar variations may exist in the nerve current. As an object photographs itself, through the effects of these variations in the energy of light, on a sensitive tablet, so the retinal picture of such an object, through similar variations in the energy of the nerve current, may produce an analogous effect on the sensitive mental tablet.

The idea of photography, of course, is offered but as an illustration of a sensitiveness of inorganic substance which imitates, though remotely, that of the mind. In the instantaneous photography of recent years plates are made of such exquisite sensitiveness as to take a good picture in a very minute fraction of a second. While these plates are kept from the light no change is produced in them. The instant the light falls upon them an exact surface copy of the object from which it emanates is produced on the sensitive plate. And this picture becomes a permanent condition of the plate. Some change has been produced in its motor or chemical organization, and the picture remains an indissoluble characteristic of its subsequent organization.[1] The parallel this presents to the mind, viewed as a sensi-

[1] In illustration of the sensitiveness of material surfaces we may quote from Professor Draper: "If on a cold polished piece of metal any object, as a wafer, is laid, and the metal then be breathed upon, and when the moisture has had time to disappear the wafer be thrown off, now upon the polished surface the most critical inspection can discover no trace of any form. If we breathe upon it a spectral figure of the wafer comes into view, and this may be done again and again. Nay, even more, if the polished metal be carefully put aside, and be so kept for many months

tive organism, is strikingly complete. We may, as an analogy, view this organism as having a delicately sensitive surface, which remains unaffected while it is kept from the influence of the nerve current, like the photographic plate when kept from the light. But the instant the energy of this current touches it a pictured image is produced which closely represents the object which instigated the nerve current. And this picture becomes a permanent condition of the mind. It indicates a fixed change in its motor organization. In this respect, however, the mind represents a photographic plate of extraordinary sensitiveness, one in which we might imagine that each picture sinks below the surface, or a new sensitive surface is immediately formed over it.

We may pursue this analogy of the organism of the mind to conceivable photographic conditions somewhat further, and reach other interesting conclusions. In this connection the relations which our mental impressions bear to each other form an important subject of inquiry. These relations are of two kinds, one of similarity, either direct or analogous, and the other of contiguity in time of reception. Each new impression seems to connect itself with all preceding similar impressions in such a manner that consciousness of the one tends to recall the other to consciousness, this effect being the more marked the greater the resemblance. As intimate a relation exists between impressions received together, although they may be very unlike. Their connection in time serves as a link of combination. They elbow each other in the mind, as it were.

These are the two distinguishing features of remembrance, and seem to point to two distinct conditions under which the mind retains its images. In regard to contiguity in time the recall of a mental image seems to recall the whole surface condition of the

(I have witnessed it even after a year), on breathing again upon it the shadowy form emerges. Or if a sheet of paper, on which a key or other object is laid, be carried for a few moments into the sunshine and then instantaneously viewed in the dark, the key being simultaneously removed, a fading spectre of the key on the paper will be seen; and if the paper be put away where nothing can disturb it, and so kept for many months, at the end thereof, if it be carried into a dark place and laid upon a piece of hot metal, the spectre of the key will come forth. In the case of bodies more highly phosphorescent than paper, the spectres of many different objects, which may have been in succession laid originally thereupon, will, upon warming, emerge in their proper order. Indeed, I believe that a shadow never falls upon a wall without leaving thereupon its permanent trace—a trace which might be made visible by resort to proper measures" (Physiology, p. 288).

mind as it existed at the time of reception of that image. It is as if, as above said, the mental organism at each period presented a clear surface for the photographing of impressions, which was immediately covered by a new-formed surface. In this view the mind seems to present itself as an unlimited series of overlapping laminæ, on each of which is photographed the thoughts and events of one period of life, while the touching of any special lamina by consciousness calls up to the mental vision all the contiguous impressions on that lamina. And the fixed hereditary constitution of the mind may be a deep-laid foundation, overlaid by these succeeding formations and far beneath the reach of consciousness, yet exercising a vigorous influence over the later developmental processes of the organism. Another point necessary to mention is that physical impressions and mental conceptions appear to affect the mind in the same manner, so that it becomes sometimes difficult to distinguish between a sensation, a memory or an idea. In states of hallucination no line of demarkation remains, and at any time the principal distinction seems that of vividness. The mind apparently retains its images in but a single mode.

The relation of similarity adds another structural feature to this conception of the mind. If we see a fine view to-day it may call up to our mental vision a somewhat similar one seen ten or twenty years ago. We have reason to believe that identical impressions flow together and strengthen their resultant, until the mind may very feebly respond to an incessant repetition of the same image. The motor conditions of the mind are so in harmony with the sensation that it produces a hardly appreciable disturbance. This would indicate that identical impressions affect a fixed locality in the mental organism, and the same may be the case, in a less exact degree, with all similar impressions. In such a case the relation would not be one of surface contiguity, but of vertical contiguity, the localized impression being in close relation of position to all similar ones lying below it in the depths of the organism. All this, of course, is pure hypothesis, yet it is of interest in connection with the phenomena of the association of ideas, if we consider the mental conditions to be the organizing relations of a substantial organism. Yet one further resultant of this analogical conception of the mind may not be amiss. The sinking of an impression below the sensitive surface of the mind

might have some relation to the frequent difficulty of recalling an old memory, and the general disappearance of memories from the grasp of consciousness, until recalled by some association. For consciousness may be looked upon as a superficial affection of the mental organism, aroused only when this surface is acted upon by cerebral energy. But present sensations might be able to connect themselves with old memories in the manner just described. And in so doing they might rouse a whole sheet of memories, spread over some deep mental lamina. The energy which produces a surface consciousness, through rapport between the mind and the cerebrum, might through this rapport of the mental laminæ make its way to deeper regions, and awake long dormant impressions of the mind.

The hypothetical idea of the constitution and development of the mental organism just given, while perhaps very remotely analogous to the reality, yet answers to the conditions of sensory reception and memory with sufficient exactness to be worthy of a clearer delineation. In this view, then, each man derives hereditarily a firmly-constituted germ of the mental organism, destitute of ancestral experiences, yet, like every part of the body, possessed of its innate habits, capable of exercising more or less control over all subsequent mental activities, and also limiting by its conditions the degree and direction of the subsequent development. This is the hereditary mind, the granite rock basis of its future formation. It has no power in itself to develop beyond this. All the other organs of the body may fully unfold from their innate forces while the mind remains in the germ. Its development is a purely individual process, and the results are not transmissible to offspring.

Still considering it as a substantial organism we seem to behold layer after layer of new substance laid down upon it, as strata are laid upon the granite basis of the geologic formation, and taking form from the form of this basic organism. Each of these lamina is delicately sensitive to the impress of external energy, and becomes covered with a series of pictured images, the fossils of the memory. With the formation of each new lamina all preceding ones are buried below the immediate contact of energy and the direct reach of consciousness. But as the impressed images on each lamina are in horizontal contact with each other, so each new impress seems to be drawn to a locality of the organism which

has been the seat of similar impressions. It is as if, in seeking entrance to the mind, it found its easiest channel at the point where impressions of some degree of similarity had already entered. Thus impressions of similar character become vertically in contact or in close contiguity.

This idea certainly offers some explanation of the phenomena of recollection, or the recall of memories. Consciousness is a resultant of the immediate relations of the cerebrum with the surface conditions of the mental organism. It has little or no penetrative power in itself. To receive an impression on a fixed mental locality does not of itself cause disturbance of the impressions which may lie below that locality. But when an impression is added to a vertical series of similar impressions, consciousness seems to make its way downward and to arouse the whole or any specially harmonious part of the series. And on thus reaching any mental lamina it may spread itself widely over that lamina and arouse to our attention a broad sheet of its impressions. Such seems the character of conscious association. No memory is recalled except through direct or indirect links of association with some present phase of surface activity. And no memory remote in time reappears until consciousness first establishes a rapport between some present impress or idea and a somewhat similar one received at that period of time.

The conditions thus impressed on the mental organism from without never remain separate conceptions, like the successive pictures in an album. They combine with each other and establish relations resembling those that exist between the originals. All we perceive are forms, qualities or conditions, and motions. Any deeper knowledge of nature must be attained through the innate operations of the mind. The received motor conditions do not lie passive in the mind, but spread under the influence of consciousness, or the energy which consciousness represents. They gradually exercise their native affinities and establish connections and relations similar to those which they possessed externally. The forces and principles which exist between external forms and conditions become evident between their mental counterparts as memories combine into ideas, and these forces and principles become in their turn objects of conscious conception. The universe tends to repeat itself fully in the mind.

But mental activity does not stop here. Forms and forces also

enter into relations which might possibly exist in outer nature, but which have never existed. Thus the mind erects an ideal world of its own, which it has the power partly to reproduce externally. This power of ideal formation is practically unlimited. The world within to some extent cuts loose from the world without, grows beyond immediate dependence upon it, reproduces the possible as well as the actual, becomes a self-centered and specialized compound of energies, and reacts as a modifying agent on that external world which has so long and so powerfully acted upon it.

As already said, the mind as a developed organism is not, like the remainder of the body structure, transmitted to offspring as a constituent feature of the germ. It must grow up in each individual anew. The most fully developed cerebrum has no power in itself to unfold the mind beyond its embryo stage, the seed of psychic existence which is derived from a long line of ancestors. The fundamental psychic conditions of our ancestors persist in our minds, not as experiences, but as strongly influencing tendencies. We cannot relegate these innate tendencies to any personal experiences, but they have the force of a large body of experiences. They form the fundamental state of our mental organism, over which are laid all its more individual states. They are a collocation of tendencies, inclinations, attributes, emotional strains, &c., which compose the original stuff of the psychic germ, the framework upon which all its later material is molded. From this original strain and the variations produced in it by subsequent experiences, proceeds our mental character, which is thus a combination of heredity and experience. Our own course of thought adds nothing to it, but the shades of change in mental character which are produced during our life may be transmitted to our offspring, and thus evolution take place in the hereditary basis of mind. This mental character forms our great moving power. It may occasionally be overcome by vigorously concentrated thoughts, yet it exercises a control over the action of nearly all our mental motive powers, and forms the great restraining agent of the mind, the concentrated wisdom of a thousand generations. But for it our actions might be very erratic, without a rudder to guide the movements of our headstrong and vagrant thoughts.

Judgment is not a passive, but an active quality. It is the name we give to the concentered vigor of all the thoughts active

in our mind in its calm state, and the sublimate of ancient thought that forms its hereditary strain. The actions we perform, the resolutions we take, are greatly subordinated to this compound of influences. They exert a force which we call will. In emotional states, on the contrary, when a few thoughts, or a single thought, perhaps, are abnormally active and the general sum of thoughts driven deep into unconsciousness, the will is differently conditioned. Vigorous and often abnormal action takes place in response to these active mental energies, and in spite of a dull protest from the nearly banished judgment. The active thought takes the bit between its teeth and runs away with us. The indications are that each conscious thought becomes an agent of control in accordance with its degree of activity, that the force resultant of all the thought activities present to consciousness at any one period constitutes the will-power, and that the action of this will be normal or abnormal in accordance with the diversity or the narrowness of the agencies active in it.

As for the control of the body by the mind, it seems almost as if the latter possessed an exact transcript of the muscular apparatus of the former. Desire to move a certain limb is accompanied by thought of that limb. Does a representation of the desired motion take place in the mind ere action is exerted on the motor nerves? Is there conscious excitation of a region of the mind which is in direct cerebral connection with the limb? We do not think of the muscles, but of the limb to be moved. As the mind contains a conscious transcript of external nature, does it also contain a complete transcript of the body, and does its self-performance of the action desired, upon its image of the physical frame, call into activity that region of the mental organism which communicates with the desired muscle? If every portion of the body is in direct connection with a fixed portion of the cerebrum, as is probably the case, then each portion of the mental organism may possess a similar connection, and to think of a limb is to rouse that part of this organism which is in immediate motor connection with the muscles governing that limb. Much of this connection must be hereditary, and its action a mentally reflex activity. But control of the body by the mind is in considerable part acquired. It seems almost as if the mind sought out the body, and only gradually completed its picture of it, or brought itself into complete motor relations with it.

The usually entertained idea that our mental picture of nature is only analogically correct, which has by some writers been carried to such an extreme as to deny that the external world exists at all, but that the mind and its images constitute the universe, calls for some attention here. The extreme view may be at once dismissed as not consistent with what we know of the laws of energy, which forbids evolutionary changes in a concrete organism except under the influence of energies received from without. And a strong argument may be brought in favor of the view that our conceptions of the external are not illusory, but that the image received by the mind is a close reproduction of the conditions actually existing in external nature.

Bodies are composed of matter, but it is matter molded by force and energy, and all form and quality are due to the interrelations of this energy. Color is due to a special action which is exerted upon the waves of light; sound to an action upon the molecules of the air. Colors and sounds, therefore, while not belonging to the body which seems to emit them, indicate special conditions or qualities of that body. By the study of these special emissions of energy we arrive at deeper conceptions of the true character of the body. Our first conception of any object is very crude and inexact. Exactitude can only be gained by a close scientific study of all these special characteristics and influences of the object. Our senses do not advise us of the real character of matter, but only of its combinations and their properties. Nor are we aware of absolute, but only of relative conditions. Our body, with its conditions, is the standard by which the universe is ordinarily measured. If our body was colder what we now call cold would become warmth. If it was firmer hardness would become softness. If it was larger largeness would become smallness. But science is rapidly ceasing to make the body the test of nature, and has made some steps from the relative towards the absolute. It declares that a certain temperature arises from a certain vigor of vibration, a certain color from a fixed rapidity of vibration, that degrees of hardness arise from fixed degrees of resistance in bodies, &c. It is true that these results are expressed in terms of space and time, and space and time extension must remain to us relative conceptions. Yet nothing else need be relative. If the apparent dimensions of objects are truly related to our conception of space and the dura-

tion of events to our conception of time, they are true to this extent, and within this limitation we may arrive at correct conceptions of existence.

Objects emit energies. These energies are external expressions of the conditions of the object emitting them. So they are acted upon by energies which they partly repel, and which are modified by their momentary connection with the object. On the other hand the energies which penetrate the object from outside act to modify its conditions. In other words, all energies exert a power of leverage. The energies emitted by any object on flowing into another forcibly impress some of their peculiar characteristics upon it. The receiving body is brought into a certain conformity of condition with the emitting body. This leverage is in constant operation, and every body is seeking to change every other body within the range of its influence into an image of itself. These emitted energies vary. Some are general, like those of heat. Others are characteristic. The degree of leverage exerted depends upon the degree of special modification in the emitted energies. Through this assimilating influence, and the counter influence of opposing energies, and of innate forces, bodies are organized.

But the influence produced by this leverage depends upon the mobility of the body acted upon. Some are rigidly centralized and vigorously resist change. Others readily yield. Some are peculiarly mobile, and may vary in condition under every impress of special energy from without, assuming some degree of similarity to the emitting bodies. In this mobility, or sensitiveness, the mental organism impresses us as far beyond any other condition of substance in nature, and therefore as peculiarly adapted to respond and vary into conditions of organization in conformity with those of the bodies acting upon it. And its power of retaining these impressions is so excessive that it is capable of receiving them in countless numbers, with little or no obliteration of those formerly received.

But this conception of the leverage of energies upon the mind and its faint resistance, leads directly to the conclusion that the mental organism is becoming, in an exact sense, a reproduced copy of external nature. The conditions of all bodies are merely arrangements of matter under the influence of innate energies. The energy is the essential constituent of condition, the matter only its inessential basis. Any substance which accepts these

modes of energy necessarily assumes similar conditions. The combination of energy without produces an equivalent combination of energy within, and the mind takes on characteristics of organization resembling those of the bodies acting upon it, precisely as the photographic plate may be said to assume surface characteristics resembling those of the bodies to whose emitted energies it has been exposed.

And this modifying influence is not exerted solely during the life of the individual, but is also an element in the hereditary conditions of the organism. It has been exerted throughout the whole phylogenetic development of the individual. The leverage of external energy is not exerted upon each mind separately to the production of changes in an original rigid substratum, but this substratum itself has been organized under the influence of such energies, from its origin in the earliest germ of psychical existence, becoming steadily more complex under the incessant play upon it of the energies of the universe. It seems to follow as a necessary consequence that our conceptions of nature must represent actual conditions, and that the whole mental organism, down to its inmost center, has been molded by external nature, and is an exact reproduction of nature to the extent that it has come into contact with it.

But this only represents the mental conditions in part. The mind has some directive control of its own forces. These interact, combination of mental conditions takes place, and results arise which have no counterpart in external nature. These, in their turn, exert a leverage on external substance, and forms are produced which exactly represent the ideal products of the mind. The mind molds nature into its own image.[1] This mental com-

[1] The molding influence of the mind upon outer nature, through the reproduction in matter of its ideal images, has a parallel in the influence exerted by the mind upon the body. We are all aware how the facial expression comes to indicate the character of the mind, and varies in accordance with mental variations. The mind has also a remarkable leverage upon the body in the cure or the production of diseases. Disease has frequently been cured by remedies which could not possibly have had any influence, simply through mental faith in their efficacy, and death has followed a mental image of mortal injury, as in the celebrated case of the fictitious bleeding of a French criminal. Very marked instances are those of the appearance of the stigmata, or the wounds of the crucifixion, in the case of St. Francis d'Assisi, and several later zealots, apparently through long mental dwelling upon the idea of the crucifixion. The credibility of these is accepted as probable by good authorities, and the ulcerous effect ascribed to mental influence on the capillary circulation through the vaso-motor centers. See "Influence of the mind upon the body in health and disease," by D. H. Luke, M. D.

bination of energies is a process which has its analogue in the outer world. Similar combinations take place in objects, and the energies received from without combine with those within to produce new conditions. If the mind has a substantial basis it must conform, in every respect, to the principles which display themselves in external compounds of substance. Yet in this respect the mind seems to be peculiarly active. The objects of the outer world consist of a dense aggregate of matter affected by a limited volume of energy. As all change is due to the interaction of this energy, external objects vary but slowly and slightly, sluggishly resisting its action. In the case of the mind we may conceive its substance to be reduced to a minimum and its energy enhanced to a maximum. Thus its mobility is extreme, its sensitiveness excessive, its interactions of energy rapid and incessant. Its powers of change and of new formation of conditions are vast as compared with those of physical objects.

And the molding of the mind of man by nature is but slightly due to its direct sensations from external objects. It is very largely produced through the medium of other minds, since a leverage exists between mind and mind as between mind and matter in producing conformity of conditions. In this indirect way a single mind may have been brought into conformity with outer nature through the intermediate influence of millions of other minds, exercised through the preservation of their ideas in books, or through their effects upon human society.

We may close here with a brief consideration of the status of the human mind if its development could be continued to infinity. In such a case it would necessarily become an infinitely complete reproduction or representation of the universe, and infinitely sensitive and mobile to any modifications taking place in the vast domain of space. In the second place, it would be infinitely capable of producing within itself new combinations of energy. It would thus be far more than an image of the universe, since to this it would add a second universe of self-formed ideas. In the third place, it would be infinitely capable of reproducing these ideas in outer nature, and thus bringing the universe into conformity with itself. Man's powers in this respect are limited, yet without changing place he has, by availing himself of the motor principles and physical conditions of nature, a very extended reach. As one example, by making the telegraph wire a virtual

extension of his body, he may exert a physical influence many thousand miles away. An infinite mind might possess infinite command of these conditions and principles, and produce effects reaching to the limits of the universe. Fourthly, consciousness would become extraordinarily developed in such a mind, and its whole vast range of memories be present at will. Prevision would have a like extraordinary development. In short, in such a mind all that we include in the name Deity would exist. It would not be the deity of pantheism, the soul of the world, any more than man's mind is the soul of the machine he has devised, and whose motion he controls. The energies of nature would exist separately from those of the deific mind, but they would be mirrored in this mind, and would be infinitely and endlessly subject to its control.

That any developing mind could reach infinity of development is, of course, impossible. If such a being as the one here considered exists, it must be as a co-eternal existence with the universe, a primordial equivalent in conscious of the physical universe in unconscious conditions. Yet consciousness and varying activity could not exist, even in such a deific mind, except through the impulse of energy received from without. Between such a mind and the universe there must be an incessant interchange of energies, with consequent modifications in the condition of each. But the mobility of mental, as compared with the sluggishness of inorganic change, must necessarily make the former the ruling agent. Once in harmonious agreement with external conditions, it would subsequently, by its rapidity of ideal combination or construction, impose constant new conditions upon external nature, and become the sole active moving force in evolution, thinking out the universe, as it were, and embodying all its thoughts in substance. This idea is offered as a curious speculation only, a corollary from the view of the mental constitution above taken, and as a hypothetical contribution to the somewhat extended list of theistical theories extant.

(To be continued.)

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— While regard for human life distinguishes the European branches of the Aryan race, it can learn a good deal from some of the other branches and races in the matter of similar humanity to the lower animals. The destruction of harmless reptiles, almost universal among the less educated members of the white race, is not practiced by some of the others, notably by the Hindoos, who might be readily excused for wholesale extermination, such is the number of venomous species in their country. The kindness of this and other races to the wild Mammalia is well known. In few countries would be practiced, except by boys and savages, the wanton firing on bison from railroad trains, such as was common in this country while that fine animal was still abundant. Few civilized people would disgrace themselves as some of our English visitors formerly did by shooting scores of buffalo which would only walk away from them. It is still a favorite pastime for equally thoughtless "sportsmen" to shoot from steamers in Southern waters that last representative of the great saurians, the alligator.

The destruction of animal life for useful purposes is of course necessary, but here the greatest folly goes hand in hand with the greatest inhumanity. When it is a question of the natural products of the earth, bison, alligators, and in fact almost all wild animals have important economic values, and the intelligent economist will preserve them on this account alone. But it is the custom, in this country at least, to kill the goose that lays the golden egg, and to let the proprietor of sheol take the hindmost. Such is the destruction of fishes by dynamite cartridges, a practice in which none but an idiot could indulge, and which is fortunately punished by severe penalties. The latest case of wanton destruction is the sweeping of our Atlantic coast of surface fishes by the nets towed by the steamers of the U. S. Menhaden Oil and Guano Association. According to the statistics gathered by the investigating committee of the Senate of New Jersey, 450,000,000 of menhaden were captured during the year 1881, and 350,000,000 during 1882, and so on, and with them an enormous number of mackerel, blue-fish, weak-fish, etc. From one of the steamers 70,000 lbs. of food fishes were purchased in thirty days.

The testimony of all classes of fishermen shows that nearly all species of food fishes have been more than decimated by the operations of this company during a very few years. Here is a case where legislation is needed on behalf of the economic interests of fish consumers, and it is to be hoped that Senator Sewell's bill will receive due attention from Congress, and that the United States Fish Commission may become the executors of a stringent law. The destruction of menhaden alone should also be restricted, since that means the extinction of a large number of marine animals which live on them, mediately or immediately.

There is a surprising shortsightedness in all these methods of destroying animal life which is not characteristic of the best representatives of our race. In general, animal products stored in the earth will be found to be more extensive and more inexhaustible sources of supply than the bodies of the existing animals themselves. It would be better to let animals live and continue their beneficent function of filling the earth with valuable fertilizers, oils, etc., than to destroy the supply at its fountainhead. Moreover, the destruction of a great many apparently useless land animals leaves the earth at the mercy of insects, whose countless hordes mankind cannot successfully overcome. And who knows how many still more insidious foes are let loose by disturbing too much the balance of life.

—— At the fourteenth meeting of the French Association, which was held at Grenoble in August last, M. de Mortillet reaffirmed his belief in the existence of man in the Tertiary period. He, however, said that the question was not to know if man as he exists at the present day already existed in the Tertiary period. Animals certainly varied from one geological stratum to another, and these variations increased as the strata were geologically distant. The higher the animals the greater the variation. It was to be inferred, then, that man would vary more rapidly than the other mammals. The problem, he said, as reported by *Nature*, was not to discover existing man in the Tertiary period, but only to find there an ancestral form of man, a predecessor of the man of historical times. The question was, Do there exist in the Tertiary strata objects which imply the existence of an intelligent being? He had no hesitation in saying there do. These objects have, in fact, been found at two different stages of the Tertiary period—in the Lower Tertiary at Thenay and in the Upper Tertiary at Otta; in Portugal and at Puy Courny in Cantal. These objects proved that at these two epochs there existed in Europe animals acquainted with the use of fire, and able, more or less, to cut stone. During the Tertiary period there existed, then, animals less intelligent than existing man but more intelligent than existing apes. This animal, to which M. Mortillet gives the name of Anthropithecus or ape-man, was, he maintains, an an-

cestral form of historic man, whose skeleton has not yet been discovered, but who has made himself known to us in the clearest manner by his works. A number of flints were exhibited from the strata in question which had been intentionally chipped and exposed to fire.

It appears that M. Mortillet carried his audience along with him, for after a long discussion the almost unanimous opinion was expressed, "that after this meeting and discussion at Grenoble, there can no longer be a doubt of the existence in the Tertiary period of an ancestral form of man!"

It is to be doubted, however, whether the slight amount of evidence which leaves no doubt in the minds of the French anthropologists will be altogether satisfactory to some of the doubting Thomases in this line of study. We shall want to examine the skull and bones, and other more conclusive evidences of human or semihuman art than those as yet discovered. Until then the truly cautious and scientific mind will hold itself in suspense.

—— The desirability of State aid to scientific research is not only deducible from the importance of the exposition of the economic resources of a country, but from the necessity of sustaining its educational interests and progress. It is well-known that some branches of scientific research are too expensive to be carried on by private individuals, excepting those of the greatest wealth, and that such persons are very rarely interested in science. Our neighbors of the Republic of Mexico are following in our own footsteps, in this respect, in the establishment of a Comision Cientifica. This body is composed of the most learned men selected from all parts of the country, and is under the presidency of Dr. Fernando Ferrari-Perez of Puebla. Its object is research in every department of human knowledge. It is making extensive collections of all the natural products of the country, and will be, as we anticipate, of great advantage to the best interests of Mexico.

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RECENT LITERATURE.

WHITE'S REVIEW OF THE FOSSIL OYSTERS OF NORTH AMERICA.[1] —This memoir is designed rather as a general review than a revision of our fossil oysters, and is addressed to the general reader. The oldest oysters, as is well known, occur in the Carboniferous rocks and belong to the genus Ostrea; while Exogyra and Gryphæa are of Jurassic age, but culminated with the genuine oysters in the Cretaceous period; the family abounded more in

[1] *Department of the Interior, U. S. Geological Survey*, J. W. Powell, Director. A Review of the fossil Ostreidæ of North America, and a comparison of the fossil with the living forms. By CHARLES A. WHITE, M.D., with appendices by Professor ANGELO HEILPRIN and Mr. JOHN A. RYDER. Extract from the fourth annual report of the Director, 1882–1883. Washington, 1884. Large 8vo, pp. 279–333, Pls. 34–82.

the Tertiary than the present age. It is melancholy to think what multitudes of these delicious bivalves lived and died, from a gastronomical point of view, in vain, with no human beings to appreciate them, unless Mortillet's Tertiary ape-man preferred oysters to tender roasts of his own species, for Dr. White assures us that the Mesozoic oyster was as good eating as those of the present day.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

GENERAL.—The Royal Geographical Society have adopted in the spelling of geographical names a set of rules, the general use of which will do much to avoid the present confusion. Familiar names, such as Calcutta, Celebes, Mecca, etc., will be retained in their present form, but with these exceptions foreign names in countries which use Roman letters will be spelled as by the respective nations. The true sound of the word as locally pronounced will be taken as the basis of the spelling, but only an approximation will be aimed at, no attempt will be made to represent the more delicate inflections of sound and accent. The vowels will be pronounced as in Italian, and the consonants as in English; every letter will be pronounced, and the only accent used will be the acute, placed upon the syllable on which stress is laid. Indian names (East Indian) are accepted as spelled in Hunter's Gazetteer. Thus: Fiji and Zulu are accepted spellings, not Feejee and Zooloo. All vowels are shortened in sound by doubling the following consonant, and the doubling of a vowel is only necessary when there is a distinct repetition of the single sound, as in Oosima. Au is to be pronounced ow as in how, thus Fuchau, not Foochow, is to be written. The sound of English f will be represented by that letter, not by ph, thus, Haifong not Haiphong. G is always hard, soft g is written j; h is always pronounced when inserted, and Dj must not be written for the sound of j. K is to be written for hard c, thus, Korea not Corea; the oriental gutturals kh and gh will be used; kw will be used for qu (Kwangtung), and y is always a consonant, and should therefore never be used at the end of a word.

AFRICA.—*M. Foucauld's Travels in Morocco.*—M. Charles de Foucauld accomplished during 1883 and 1884 a remarkable journey of exploration in Morocco. Renouncing his prospects in the military career, he disguised himself as a Jew, concealing his barometer and sextant under the long veil with which the Jew covers himself during prayer. Without servants, tent or bed, without baggage or horse, he traveled and worked eleven months among people who, had they unmasked him, would have killed him as they have others. Little was known of the geography of Morocco before his journey. The first map of the country on the scale of 1 : 2,000,000 was drawn up in 1845 by M. Emilien Renou. Three years afterwards this was revised by Capt. Baudouin, and the scale increased to 1 : 1,500,000. To the 7600 miles of roads marked out, with but few determinations of latitude and still fewer of longitude, M. de Foucauld had added 1400 miles of new ground, besides revising and perfecting the

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

work of his predecessors. From Cape Guir or Ghir to the Algerian frontier the length of the great Atlas range was known to be 435 miles, but only four points had been determined by previous itineraries. M. de Foucauld crossed the chain at several new points, of which he determined the altitude, besides journeying 185 miles along the base of the range, studying the orography of the country. The main range is flanked by parallel lines of elevation. There is in the north a chain of mountains 185 miles long, which bears the names of Djebel-Ait-Seri and Djebel-Beni-Uaghain, and in the south there is first of all the Little Atlas, and further south the strange outline of the Djebel-Bani range. In Dec., 1883, M. Foucauld touched the Wady Dhrâ'a to the south of Tattas. It was dry. Later on he saw it further to the north-east, in the district of Mezquita, where it flows through plantations of date-palms. The part of this river indicated on Dr. Rohlfs' maps is by M. de Foucauld placed one degree further west. M. H. Duveyrier, the writer of the report of M. Foucauld's journey, is now traveling in Morocco.

African News.—The Rev. G. Grenfell has contributed to the Royal Geographical Society a chart of the Mobangi, which proves to be a great navigable stream, flowing nearly from north to south across the blank on our present maps of Africa between the sources of the Benue and Shari to the Congo. Mr. Grenfell ascended this river from its junction with the Congo, in a delta extending from 26 to 42 minutes south of the equator, to 4° 27′ N. latitude. Throughout the whole district it is a magnificent stream, with a mean depth of twenty-five feet, and at the furthest point it was still an open water-way. The country around is richly wooded and seems fertile, and the banks are more densely populated than those of the Congo. It is full of islands.——Professor Ratzel, in Petermann's Mitteilungen for July, seeks to show how misleading it is to color a map of Africa with definite political boundaries. The state of culture in Africa is as varied as the ethnology, and these stages of culture are the prime element in the so-called political geography of Africa. Professor Ratzel divides Africa into twelve "State-forming" peoples, under the two great sections of North African and Soudan States, and Negro States.——Dr. Mannington, bishop of Equatorial Africa, has attached himself to a Swahili caravan to explore a route, different to that followed by Mr. Jos. Thomson, via Chagga and the Masai country, to the eastern shores of Victoria Nyanza.——Some Swedish merchants have purchased a tract of land in the Cameroons, and have established a considerable trade with the natives.——Sig. Buonfanti has published a reply to the doubts of Herr G. A. Krause respecting his journey across the Sahara and Western Sudan to Guinea. The writer's letter to the Bolletini of the Italian Geographical Society is dated May 6th, on board

the *Corisco* at Banana. Documentary proofs of his trip, including translations of safe-conducts and firmans from the sultans of Bornu and Socoto, etc., are, he says, under lock and key at Brussels, and will, with the originals, be produced. Herr Krause heard nothing of his movements, because he did not reach the coast there, but at Portonuovo, some forty-five miles further west. Nothing was heard of him in the Yoruba country, because he passed 200 miles to the east of it.——The African travelers, Yuncker and Casati, are, according to a telegram received in Berlin, at Lado, an Egyptian military post on the Bahr-el-Jebel.——M. Coudreau has, as one of the results of his six journeys in Guiana, brought back materials for two new maps, the one of the region between the Oyapock, Yari, Amazons, and Atlantic, the other of Southern Guiana between the Branco and Paru.——M. Ballay, at the meeting of the Geographical Society of Paris, on April 25th, gave an account of his journey with two canoes (in sections) to the Alima from the Upper Ogowé. The intervening region is an arid steppe strewn with human remains. He established a peace with the Apfurus.——M. Leon Guiral has sent to the Geographical Society at Paris, a description of the west coast of Africa about the mouths of the San Benito or Eyo and the Dote, 7½ miles further south. The Eyo is a mile in width at its mouth. Banks of rocks bar the entrance, but the left arm is navigable for vessels drawing two meters of water. The banks are marshy. M. Guiral ascended it about thirty kilometers, to Iniger, where there are falls. It has several tributaries, some of them navigable for canoes. The Dote is a river of little importance, with marshy banks, and is about a meter deep and forty meters wide along the lower part of its course. It can be ascended in a canoe for about twenty-one miles. The commerce of the district concentrates in the village on the right bank from which it takes its name. The natives are tall and are good canoe-men, but given to brandy.——The death of Mirambo, in December last, is confirmed; it was followed in January by that of Kapura, his principal adversary.——The International Association has handed over Karuma and Mpala to the Algerian missionaries, who previously possessed five establishments in the region of the Great Lakes. ——The protectorate of France now extends along the whole north coast of the Gulf of Tadjura as far as Bahr-Assal, and M. Caspari states that the relations of France with the Danakils are cordial. Obock is at least a safe and easily accessible harbor, and the abundance of water renders possible the cultivation of vegetables.——The German East African Expedition, commenced five years ago, has now been brought to a close, and Herr Paul Reichard, its only survivor, has probably by this time reached Zanzibar. Dr. Bohm and Herr Reichard crossed the Luapula into Urua, where the former died. After his death his companion ascended the Lufira as far as the famous copper

mines of Katanga. The wide region lying between the Lualaba, Urna, the Kande Irunde mountains, and Iramba, is governed by a powerful chief called Msirri. The Lualaba bounds his dominions on the west, and is a considerable river, 400 to 600 yards wide where Herr Reichard saw it, and navigable as far as Manyuema This river, which from its volume must be looked upon as the real head of the Congo, flows through Lake Upemba. The Lufira, which is tributary to it, flows through the center of the country. It rises twenty days' journey to the south of Katanga. Katanga, the exceedingly rich copper mines of which are at present unworked, is about 250 miles south-west of Luapula, and forms part of Msirri's dominions.

AMERICA.—*American News.*—In the August number of the Proceedings of the Royal Geographical Society, Mr. E. im Thurn gives a full account of the difficulties incurred in the journey to and ascent of Roraima, as well as of the botanical rewards obtained. The general aspect of all the plants on the summit is dwarf, almost alpine, but many lovely flowering plants, including one closely resembling the crown imperial, and a luxuriant pitcher-plant (Heliamphora) occurred, with a few ferns and one shrub five or six feet high. The top of the mountain is not flat, but forms a shallow basin, the edge formed by the rugged edge of the cliff. This basin is divided up into a vast number of smaller shallow basins, separated by curiously terraced ridges of rock, often of crescentic or even ring-like shape. These basins hold a quantity of water, and every shower of rain suffices to swell the water to such an extent that cascades fall over the cliff. Sir Robert Schomburgk states that the water seems to flow, not from the top of the cliff, but from points some distance below. This is readily explained, for it flows through deep and narrow sloping channels, often cut parallel with the face of the cliff and hidden by projecting promontories. The statement of previous travelers which Mr. Im Thurn found hardest to explain was that the top is covered with trees. This has been made with reference to the southern end, where there are certainly none, and our traveler believes that the rugged pinnacles and points of rock have been mistaken for trees.——M. Chaffanjon, writing from Ciudad Bolivar, in May, states that with two Ariqua Indians he passed up the Caura river to its source, and obtained a mass of curious information respecting the manners and religious beliefs of the Arebatas, Penares and other tribes. He was also able to visit and study the Yaruras and Mapayes. His explorations on the Orinoco have enabled him to rectify many errors in the charts of its course.——Dr. Finsch is returning to Europe from his recent exploring expedition along the unknown portions of Kaiser Wilhelmsland, which are situated between Astrolabe bay and Humboldt bay. He reports the discovery of several good harbors and of a navigable river. The natives were friendly.

ASIA.—*Asiatic News.*—Sibiriakoff, the friend and patron of Nordenskjold, during the summer of 1884 ascended the Petchora to Oromets, then crossed the Ural to the Sigva or Whitefish river, which flows in the Sosva affluent of the Obi, and reached Shikurik Sept. 2. The journey demonstrates that a trade route is open in this direction in summer.——Cols. Lockhart and Woodthorpe have been despatched with a party to Gilghit, and it is intended that full surveys of the region lying to the north-west of Kashmir shall be executed. Several passes of no great difficulty here lead towards the Russian possessions, which approach closely.——Colonel Woodthorpe has just completed a journey through the Singpho country. He penetrated into the land of the Bor Khamptis on the northern Irawadi, where no traveler is believed to have been since Lieutenant Wilcox's tour in 1828. Several mines lie north-east of Pedan, the capital, and are worked by an inferior and half-subject race called Khanungs. The Irawadi is unnavigable at Pedan.——The journeys of Dr. Neis in Central Taos (more than 3000 miles) have resulted in a vast amount of information regarding the commercial routes of the western basin of the Mekong, the anthropology and ethnology of the Laos and the Khas, and the social, commercial and political condition of the regions visited.

EUROPE.—*European News.*—Recent examination of bench marks made in 1851 along the Swedish coast of the Baltic show that the movement of elevation was continued in the north, and that of depression in the south of the Scandinavian peninsula. Compared with previous observations, the results prove that since 1750 the head of the Gulf of Bothnia has risen 2.10 meters. About Calmar and Carlscrona no change of level could be detected, but the general result is an elevation of the Swedish coast at the mean rate of 1.60 meter per century.——Four arctic expeditions are said to be projected for next year. Holland will send one, Denmark one and Portugal, newly awakened, it would appear, to the love of discovery, will send two. All propose to visit the Russian islands of the glacial ocean, but the Danish expedition will specially explore the Kara sea, to define as far as possible the unknown region which is supposed to lie to the north-east of Novaya Zemlya.——The captains of several Norwegian steamers despatched to Greenland for seal-hunting, report that the east and south coasts are so obstructed by ice that no seals have been killed.——The population of Iceland in 1880 was 72,445, all of whom were Lutherans, except 3 Mormons, 1 Catholic, 1 Unitarian, 1 Methodist and 3 of no religion in particular.

GEOLOGY AND PALÆONTOLOGY.

ON THE PRESENCE OF ZONES OF CERTAIN SILICATES ABOUT THE OLIVINE OCCURRING IN ANORTHOSITE ROCKS FROM THE RIVER SAGUENAY.—While engaged during the summer of 1884

in making a geological examination of a portion of what has proved to be a very extensive area of anorthosite rocks, which belong to what has been called the Norian or Labrador series, occurring about Lake St. John and the Upper Saguenay, and which from thence strikes far away to the north, I noticed in many of these rocks a mineral which weathered to an orange color and which, when the weathered surface of a specimen containing it was carefully examined, was invariably seen to be surrounded by a narrow light green border. On my return to Ottawa in the fall a large number of thin sections of these rocks were prepared and were found on examination to exhibit a most interesting phenomenon, which I propose here to describe briefly.

The mineral olivine has never heretofore been mentioned as occurring in the Norian series in Canada, although Dr. Hunt, I believe, has mentioned it as a constituent of certain boulders of anorthosite rock, referable to this series, which were found in New Hampshire, but which were probably carried thither from Canada during the glacial age. The mineral, however, occurs abundantly in the anorthosite of many parts of the Saguenay area, and I have also found it in a specimen from a little area of rocks which has been referred to this series, and which occurs near Dolin's lake, in New Brunswick.

When thin sections of the massive or nearly massive dark violet anorthosite from the shore of Lake St. John, near the Little Discharge of the Saguenay, is examined with the microscope, the rock is found to be composed of plagioclase, olivine and iron ore. The plagioclase occurs in large well twinned individuals, which are seldom broken or twisted, and which between crossed trichols show nothing of the peculiar, wavy appearance so often seen in the feldspar of the Laurentian gneiss. The iron ore which is present only in small amount is probably titaniferous, as in one slide a grain of it is seen partially altered to leucoxene. The olivine, of which the rock usually contains a large quantity, occurs either in single individuals, or especially in the larger grains, as several individuals united to form one grain. They seldom have any resemblance to proper crystalline forms, but one usually irregular in shape, a single individual sometimes forming a very irregular elongated string. It is recognized by its bianial character, high index of refraction and imperfect cleavage, and although like the plagioclase very fresh, by the presence of a little serpentine which here and there may be detected along the cracks which traverse it. The olivine, as is usually the case in eruptive rocks, crystallized before the plagioclase and therefore lies imbedded in it; but although I have examined a very large number of thin sections of this rock, I have never been able to find these two minerals in contact, there being invariably two zones of certain other silicates surrounding the olivine and intervening between it and the plagioclase, so that since the rock consists almost entirely of these

two minerals, every grain of olivine is seen to be completely surrounded by this double zone.

The zone, next to the olivine, is colorless, or nearly so, but often shows a slight pleochroism with reddish and greenish tints. It is formed of small individuals grown compactly together and considerably elongated in a direction at right angles to the surface of the olivine. When examined with a high power the mineral is seen to possess two sets of imperfect cleavages, and when these cross one another at right angles, the direction of extinction bisects the right angle. When cut perpendicular to an optic axis, it shows the revolving bar of a biaxial crystal.

The second zone, or that next to the plagioclase, forms a fringe about the zone just described and consists of minute needles of a light green fibrous mineral arranged at right angles to the surface of the inner zone and penetrating into the plagioclase, so that their examination is attended with considerable difficulty. They are, however, seen to be slightly pleochroic with different shades of green and to have an extinction which makes a small angle with the length of the fibers. It has exactly the appearance of actinolite, as that mineral is generally seen in thin sections, and that it is really a variety of hornblende is proved by the fact that in another specimen of the same rock collected a few miles away, in which the zones are still seen in all their perfection, the outer one is no longer fibrous, but shows the cleavage and absorption characteristic of hornblende.

The olivine and the minerals composing the two zones are entirely differently orientated, and the breadth of the zones does not bear any absolutely constant relation to the size of the olivine grain as seen in the slide, since this latter would vary greatly, according to the direction in which the section passed through it. The inner zone, however, is always smaller than the outer one.

Although the mineral forming the inner zone has the characters of a pyroxene, no conclusive evidence as to its nature could be obtained from the sections of this rock. Similar double zones are, however, found about the olivine in rocks from other parts of the area having the individuals of the inner zone better developed. In these the pleochroism and rude cleavage are very distinct. In a section of one of these rocks a grain of pyroxene exactly resembling the mineral of the inner zone, but not associated with the olivine, was so cut that it could be proved to be a rhombic pyroxene, in that on a basal section known by the cleavages being at right angles a bisectrix could be seen. It may therefore be said that the inner zone is *probably* composed of a rhombic pyroxene, while the outer one is certainly hornblende.

Positive information respecting the nature of the mineral forming the inner zone can only be obtained by separating some of it by means of a heavy solution and examining the powder so obtained. This I propose to attempt, and will make known the

result in a paper on these rocks which is now in course of preparation.

Although these zones have been mentioned by three or four writers, Dr. Törnebohm, who first observed them in certain gabbros from Sweden (Neues Jahrbuch für Mineralogie, &c., 1877, p. 383), is, so far as I am aware, the only one who has described them. Owing to the kindness of that gentleman I have had an opportunity of examining thin sections of a number of these Swedish rocks. The double zone is well seen in them, but is much smaller than in the Canadian rocks, and the minerals composing it accordingly more difficult to determine. Dr. Törnebohm, although unable from his sections to determine the nature of the inner zone, rightly regarded the outer one as hornblende.

The chief interest attached to these zones arises from the fact that, as Törnebohm remarks, they appear to have originated from a mutual reaction between the olivine and the plagioclase. An examination of the thin sections of the Saguenay rock impresses one strongly with the conviction that they have resulted from the action of the molten plagioclase magma on the olivine grains, which in eruptive rocks always separate out before the plagioclase, thus having an origin similar to the kelyphite zones about pyrope described by Schrauf, and somewhat analagous to the zones about olivine and hornblende in volcanic rocks, which have recently attracted so much attention. The subject is one of importance as indicative of the processes at work in the genesis of rocks, and also as throwing some light on the much discussed question of the origin of these anorthosite rocks.—*Frank D. Adams, Geological Survey of Canada.*

EOCENE PADDLE-FISH AND GONORHYNCHIDÆ.—The Polyodontidæ or paddle-fish are only known from the American and Chinese rivers, and no trace of them has been found hitherto in the records of earlier periods of time. It is therefore of much interest to zoölogy that I am able to announce the existence of remains of a species of this family in the Eocene Green River shales of Wyoming Territory. This determination is based on a skull, of which one side is fairly well preserved, of an individual of the size of a middle-aged specimen of the common paddle-fish (*Polyodon folium*). The long snout is somewhat damaged, but was less dilated than in that species, being intermediate in character between the snouts of the American and Chinese forms (*Psephurus gladius*). The stellate bones are smaller and more attenuated than in the *P. folium*, and the gape of the mouth is not quite so wide. The symphyseal bone, enclosing Meckel's cartilage behind, is much smaller. There is a bone in contact with the front of the operculum below, which may be one of two or three elements, which is apparently not present in Polyodon, at least not in that position. For this reason I propose to distinguish this fish generically

from Polyodon. The probable body of this species was described in the NATURALIST, 1883, p. 1152, under the name of *Crossopholis magnicaudatus* Cope.

While the preceding species fixes the age of a type distinctively of the northern hemisphere, I have to add another to those which testify with equal certainty to the presence of southern hemisphere forms as present in North American waters during the Eocene period. This is a member of the family of the Gonorhynchidæ, a group which is now confined to the southern parts of Africa, and to Australia. The species, which is represented in my collection by two fine specimens, is about as large as a fully grown pickerel, but of more slender proportions. The head is short and the mouth small and edentulous. In its generic characters it agrees generally with Gonorhynchus, but differs in the absence of prominent hyoid and pterygoid teeth. The scales are broadly fringed at the margin, like those of the cotemporary genus of Aphredodiridæ, Amphiplaga, and the Trichophanes of the Amyzon beds. The dorsal and anal fins are posterior and opposite. Radii, D. I. 13; V. 8; A. II. 8. Vertebræ Ab. 34 C. 14½. Depth six and three-quarters times in length; head six and a half times in length. The genus and species may be called *Notogoneus osculus*.

A survey of the fish-fauna of the Green River shales yields the following results: Of North American existing fresh-water types we now have represented Lepidosteidæ, Polyodontidæ, Aphododiridæ and Percidæ. Of southern hemisphere types, Gonorhynchidæ and Osteoglossidæ.—*E. D. Cope.*

A CRITIQUE OF CROLL'S GLACIAL THEORY.—A paper before the Geological section of the British Association, by W. F. Stanley, F.G.S., had the following points: The theory of Dr. Croll, accepted by many geologists, is that former glacial periods in the northern hemisphere were due to greater eccentricity of the earth's orbit and to this hemisphere being at the time of glaciation in winter perihelion. This theory is supported upon conditions that are stated to rule approximately at the present time in the southern hemisphere, which is assumed to be the colder. Recent researches by Ferrel and Dr. Hann, with the aid of temperature observations taken by the recent transit of Venus expeditions, have shown that the mean temperature of the southern hemisphere is equal to, if not higher, than the northern, the proportions being 15.4 southern, 15.3 northern. The conditions that rule in the south at the present time are a limited frozen area about the south pole not exceeding the sixtieth parallel of latitude, whereas in the north frozen ground in certain districts, as in Siberia and Northwestern Canada, extends beyond the fiftieth parallel; therefore, by comparison, the north, as regards the latitude in which Great Britain is situated, is at present the most

glaciated hemisphere. As it is very difficult to conceive that the earth had at any former period a lower initial temperature, or that the sun possessed less heating power, glaciation in the north could never have depended upon the conditions argued in Dr. Croll's theory. The author suggested that glaciation within latitudes between 40° and 60° was probably at all periods a local phenomenon depending upon the direction taken by aërial and oceanic currents, as, for instance, Greenland is at present glaciated, Norway has a mild climate in the same latitude, the one being situated in the predominating northern Atlantic currents, the other in the southern. Certain physical changes suggested in the distribution of land would reverse these conditions and render Greenland the warmer climate, Norway the colder.

OCCURRENCE OF A DEEP-SEA FORAMINIFER IN AUSTRALIAN MIOCENE ROCKS.—At the meeting of the Royal Society of South Australia, on June 2, Mr. W. Howchin, F.G.S., exhibited a specimen of *Astrorhiza angulosa* as a fossil found in the Miocene strata of Victoria. The specimen was stated to be of more than ordinary interest, inasmuch as it was the first instance in which the genus had been found in the fossil condition in the recent slate. The species submitted was very rare, having been hitherto known to occur only at two localities, one of these being at a *Challenger* station to the east of the Azores, at a depth of 1000 fathoms, and the other at a point in the North Atlantic, dredged by the *Porcupine*, at 630 fathoms, where only a single specimen was taken. There are five species in the genus, but with the exception of a single specimen of an allied species taken by the *Challenger* off the Cape of Good Hope, the genus is only known as a North Atlantic type. The species discovered in the Victorian rocks is one of the rarest; its occurrence, therefore in the fossil condition in the Australian Tertiaries is a matter of some interest. The speaker stated that his researches with regard to the microzoa of the Australian formation led him to believe that many of the rarer arenaceous forms of foraminifera recently discovered in the deep seas, and which have been so beautifully illustrated by Mr. H. B. Brady in the Scientific Results of the *Challenger* Expedition, occurred as fossils in Australian geology from the Cretaceous formation downwards.—*English Mechanic.*

GEOLOGICAL NEWS.—*General.*—Prof. P. M. Duncan has contributed to the Quarterly Journal of the Geological Society an account of the structure of the ambulacra of some fossil genera and species of regular Echini, explaining the effects through generations of crushing upon the characters of the ambulacral plates, and the gradual formation of complicated ambulacral plates.—— According to W. Dames and H. Woodward, some at least of the forms which have been described as Phyllopod-shields, from strata of Silurian, Devonian, and Carboniferous ages, are nothing

more than the opercula of Goniatites. Both agree, however, that for other forms this explanation is, according to our present knowledge, inadmissible. W. Dames, however, asserts that none are phyllopodous in their nature, a dogmatic opinion for which he is taken to task by the English palæontologist. They are, in fact, species of Phyllocarida, and not phyllopods.

Carboniferous.—Since 1878 no less than 1300 specimens of fossil insects have been obtained at Commentry, while all other localities have only furnished about 120 examples. These Commentry insects are remarkably well preserved, many of them being complete, instead of consisting of the wings only, as is often the case with insect remains. M. Ch. Brongniart (Revue Scientifique, 29 Aout, 1885) classifies these carboniferous insects as Orthoptera, Neurorthoptera, Pseudo-neuroptera, and Hemiptera. Among the Orthoptera are fifty specimens of *Dasyleptus lucasi*, an ancestral Thysanouran, and numerous Palæoblattariæ and Palæderidiodea. The Neurorthoptera comprise the order of that name and the Palæodictyoptera; the first with the families Protophasmida and Sthenaropterida, and the second with the families Stenodictyopterida, Hadrobrachypoda, and Platypterida. The wings of *Archæoptilus lucasi* are twenty-five to thirty centimeters long, and those of Eugereon and other Stenodictyopterida are finely netted like those of dragonflies. The Hadrobrachypoda are regarded as ancestral types of the Termites. The Platypterida are entirely new. Their wings are broad, generally rounded at the end, and though morphologically like those of the Protophasmida, differ greatly in the nervation. The nerves are well separated, and the wings colored. Six familes of Pseudo-neuroptera can be distinguished, the Megascopterida, Protodonata, Homothetida, and three others containing the ancestral types of the Ephemeridæ, Perlidæ, and Ascalaphus. The Hemiptera are represented by types of the Fulgoridæ and Cicadidæ.

Cretaceous.—Mr. J. S. Gardner denies the synchronism of a large part of the American Cretaceous with that of England. Whether the former are Cretaceous at all is debatable. The question whether a Cretaceous fauna extended into the Eocene, or an Eocene flora extended back to the Cretaceous is answered by Mr. Gardner in these words: "In support of the first proposition we have the innumerable survivals of old types at the present day, wherever the struggle for existence has been less severe, and the fact that the Cretaceous-looking types are largely mingled with others of a Tertiary facies. The Tertiary facies of the flora, on the other hand, is not diminished by the presence of any distinctly Cretaceous plants. I think all the evidence I have been able to bring forward is in favor of a newer rather than an older date, and this is decidedly more in harmony with the march of evolution."——Mr. J. S. Gardner (Quart. Jour.

Geol. Soc., Feb., 1884) describes the British Cretaceous Nuculidæ. Palæontology bears out the separation of the Nuculæ and Ledæ from the Arcidæ. He recognizes fifteen species of Nucula in the limits treated, ten of the group of Ovatæ, the remainder of the group Angulatæ. The Ledæ are ten in number. *Nucula meyeri*, *Nucula gaultina* and *Leda seeleyi* are new species.

Tertiary.—The third part of M. Gosselet's geological sketch of the north of France and the adjoining countries contain sixteen plates, and treats of the Tertiary period, which is divided into Eocene, Oligocene and Neogene. The following are enumerated as "Pretertiary continental formations": Vegetable soil (loam with lignite in its upper bed), flint conglomerate (sand with beneath it clay with flints), Pretertiary loam (loam, plastic clay and sand) and transported Pretertiary deposits. The Eocene is divided into Montian, Landenian, Ypresian and Parisian, the last characterized by *Rostellaria ampla*, *Nummulites lævigata* and *variolaria*, *Ditrupa strangulata*, and its glauconitic zone by *Pecten corneus*. In the Eocene of Northern France the only vertebrates known are *Arctocyon primævus* and *Pachynolophus maldani*, but the Oligocene has yielded Anthracotherium and many birds, also *Crassitherium robustum*, allied to Rhytina. M. Gosselet divides the Oligocene into Tongrian (principally marls and sands) and Rupelian (Beauce limestone). The Neogene is represented in Northern France and Belgium only by its upper or Pliocene beds.——The description of chilostomatous Bryozoa from Aldinga and the Murray Cliffs, S. Australia, by A. W. Waters, is still continued in the quarterly journal of the Geological Society. The number of fossil species now known is 220, just about half of which have been found living. They are principally from the Tertiary, but a few are Cretaceous.——E. T. Newton (*Geo. Mag.*, Aug., 1885,) describes some bones of a gigantic bird obtained from the Lower Eocene at Croydon, Eng. The most interesting portions are two large tibiæ-tarsi and parts of a femur. These bones very closely resemble the corresponding parts of *Gastornis parisiensis*, but present specific differences. The bird, which must have been as large and heavy in build as the *Dinornis crassus* of New Zealand, has been named *G. klaasenii* in honor of its discoverer, Mr. H. M. Klaasen.

Recent.—The two articles of Prof. J. D. Dana (*Amer. Journ. of Science*, Aug., Sept., 1885), are an able defence of the until recently almost universally accepted theory of the origin of coral reefs and islands by subsidence. The great number of atolls and barriers in all stages to be found in the deep belt of the Pacific, are shown to be inexplainable upon any other theory, while islands like the Marquesas, though without reefs, yield unmistakable evidence of the wide spread subsidence. The views of Darwin and Dana are shown to be those of men who had a wide

acquaintance with the general phenomena; it is admitted that local elevations occurred, and some of the widely isolated points thus elevated are enumerated, and other explanations of the phenomena are passed under review, but dismissed as either insufficient or actually confirmatory of Darwin's theory. The soundings of Mr. Murray off northern Tahita, showing the rapid increase of depth beyond the forty fathom line until, at a mile from the shore, the slope of the ocean bottom was nearly that of the land, are shown to be exactly in accordance with the subsidence theory. The strongest evidence, derived from the writings of A. Agassiz and the soundings of the *Blake*, points to a great subsidence in the Florida region during the coral reef era, and the elongation of the coral reefs and formation of inner channels now going on by drifting coral sands is shown to be but a part of the sand-beach forming process which is in operation along the entire Atlantic coast of North America, from Long Island southward, and to in no way vitiate the evidence in favor of previous subsidence. The abrasion-solution theory of Semper seems to be negatived by the absence of open channels in the lagoons of the smaller atolls, moreover, instead of small lagoons having the purest waters, it is they which are most choked by coral sands.——Almost perfect skeletons of *Rhytina gigas* have been recently mounted in the National Museum, Washington, and in the British Museum.

MINERALOGY AND PETROGRAPHY.[1]

NEW MINERALS.—*Gerhardite.*— Messrs. Wells and Penfield[2] have described natural crystals of a basic copper nitrate which was first identified by Professor Brush, of New Haven, on specimens of copper ore from the United Verde mines, Jerome, Arizona. The crystals, which belong to the orthorhombic system, are mainly made up of a large series of pyramids and the basal pinacoid. Twelve forms were observed. Color dark green; hardness 2; specific gravity 3.426. Plane of the optic axes is the brachypinacoid; double refraction very strong, negative; pleochroism distinct.

An analysis gave:

H_2O	CuO	N_2O_5
11.26	66.38	22.25

Named after the chemist who first determined the composition of the same compound made artificially. This is the only insoluble nitrate known in nature.

Hanksite.—This name was suggested in May of the present year, by Mr. W. E. Hidden,[3] for an anhydrous sulphato-carbonate

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore.

[2] *American Journal of Science*, July, 1885, p. 50.

[3] Ib., Aug., 1885, p. 133.

of sodium occurring in San Bernardino county, Cal. This mineral was exhibited at the New Orleans exposition as thenardite, but was proven by both a crystallographic and optical examination to crystallize in the hexagonal instead of the orthorhombic system. Chemical analysis by Messrs. Mackintosh and Penfield[1] indicate for the formula of this mineral: $4\,(Na_2SO_4) + Na_2CO_3$, with some admixture of potassium and sodium chlorides. The name was assigned in honor of Professor Henry G. Hanks, State mineralogist of California.

Elpasolite is proposed by Messrs. Cross and Hillebrand[2] for a variety of cryolite in which about two-thirds of the sodium is replaced by potassium. Their analysis gives:

Al	Ca	Mg	K	Na	F	Total
11.32	0.72	0.22	28.93	9.90	46.98	98.08

It was found in small cavities in the massive pachnolite occurring with other minerals of the cryolite group at El Paso county, Colorado.

American Minerals.—The last published bulletin of the U. S. Geology Survey (No. 20) entitled "Contributions to the Mineralogy of the Rocky mountains," by Messrs. C. W. Cross and W. F. Hillebrand, contains much valuable information regarding Colorado minerals. A large portion of the matter has already appeared in the pages of the *American Journal of Science* and of the proceedings of the Colorado Scientific Society, but the republication of these papers with many corrections and additions is very welcome. The first chapter deals with the zeolites which occur in the basalt of Table mountain, near Golden, Colorado. The following species were observed, the order of crystallization being: (1) laumontite (oldest); (2) stilbite; (3) thomsonite; (4) calcite (yellow); (5) stilbite; (6) chabazite; (7) thomsonite; (8) analcite; (9) apophyllite; (10) calcite (colorless); (11) mesolite. Natrolite, scolecite and levynite were also found; but not in associations which warranted certain conclusions regarding their relative ages. The analcite and apophyllite exhibited optical anomalies similar to those observed in these minerals from other localities. Chapter second deals with the minerals occurring near Pike's Peak. These occur in veins and druses of a coarse red granite supposed to be of archæan age. The most interesting of these minerals are members of the cryolite group, of which seven species were identified, viz: (1) cryolite upon which by a study of the lamellæ five different twinning laws were found, *i. e.*, twinning plane ∞P; $\frac{1}{2} P$ (r) $\infty P \bar{\infty}$, $\frac{1}{2}P$ (l) and—$\frac{1}{2}P$ (l); (2) pachnolite; (3) thomsenolite; (4) ralstonite (?); (5) gearksutite to which Flight's "Evigtokite" (vid., Naturalist, 1885, p. 708) is reckoned; (6) El-

[1] *American Journal of Science*, Aug., 1885, p. 137.

[2] Bulletin U. S. Geol. Surv., No. 20, p. 57.

pasoite (no. sp.); (7) proposite. Phenacite, zircon, topaz, cassiterite, fluorite and several other species also occur in the granite of Pike's Peak, in addition to the common microcline and smoky quartz. Minor investigations on the luster of sanidine in certain rhyolites; on the occurrence of topaz in nevadite; short notes on many observed minerals, including the two new species zunyite and guitermanite, already mentioned in the NATURALIST's notes, make up the other chapters.

Bulletin No. 12 of the U. S. Geological Survey contains a very interesting study, by Professor E. S. Dana, of "thinolite," a name applied by Mr. Clarence King to an enigmatical calcite pseudomorph which occurs abundantly in the old lake basins of the far West. This mineral was at first considered a pseudomorph after gaylussite; Professor Dana, however, shows that this cannot be the case as the original form was clearly tetragonal. What the chemical composition of the original mineral was, it is impossible to state with certainty, but judging from the analogy of well-know n lead-carbonate pseudomorphs after phosgenite ($PbCO_3 + PbCl_2$), the author thinks it quite probable that the original form may have been a similar double salt with the composition $CaCO_3 + NaCl$[1] or $CaCO_3 + 2NaCl$.

M. S. L. Penfield[1] has described crystals of the rare selenide of mercury, tiemanite, from Marysvale, in southern Utah. They are tetrahedral and closely resemble crystals of sphalerite. Observed forms are $\infty O \infty$ (a); $+\frac{O}{2}$ (o); $-\frac{O}{2}$ (ó); $+\frac{5O5}{2}$ (w) and $+\frac{\frac{7}{3}O\frac{7}{3}}{2}$ (φ) — other indistinct positive hemi-trisoctahedra appear on some crystals as striations. The crystals measure less than 3^{mm} in diameter. They are of a black color with a high metallic luster. Twins parallel to the octahedral face are very common.

The same writer[2] also describes crystals of the allied black sulphide of mercury, metacinnabarite, which has heretofore been generally regarded as amorphous. They come from the Reddington mine, Lake Co., California, and measure as much as 4^{mm} in diameter. This mineral is in all respects isomorphous with tiemanite. Observed forms are $\pm\frac{O}{2}$; $\pm\frac{\frac{3}{2}O\frac{3}{2}}{2}$, $\pm\frac{2O2}{2}$ and $\frac{\frac{9}{5}O\frac{9}{7}}{2}$ (?).

The intermediate compound, onofrite, Hg (S, Se), is not yet known in distinct crystals, but is doubtless isomorphous with the two minerals mentioned above.

Mr. Penfield[3] has likewise described and figured some interesting analcite crystals from the Phœnix mine in the Lake Superior copper region. They show the usual trisoctahedron, 2O2, with

[1] American Journal of Science, June 1885, p. 449.

[2] Ib. p. 452.

[3] Ib., Aug., 1885, p. 112.

each edge replaced by a reëntrant angle. A microscopic examination of thin sections of these crystals shows that they are divided into four secants with a faint irregular action on polarized light. Very many crystals show a perfect but small trisoctahedron in their center, around which the exterior portion appears to be a secondary growth.

Mr. J. P. Iddings[1] of the U. S. Geological Survey communicates a very interesting account of minute fayalite crystals which occur in the lithophyses of the obsidian and rhyolite in the Yellowstone Park. They are less than 2^{mm} in length, black in color and tabular in habit. The following forms were determined by Mr. Penfield: $\infty \bar{P} \bar{\infty}$, $\infty \breve{P} \breve{\infty}$, $\infty \breve{P} 2$, P, $\bar{P} \bar{\infty}$ and $2 \breve{P} \breve{\infty}$. An analysis by Dr. Gooch gave:

SiO	FeO	MgO
32.41	65.49	2.10

Fayalite has heretofore been known only on artificial slags to which the obsidians of the Yellowstone have a close resemblance.

Messrs. Cross and Iddings[2] describe the wide-spread distribution of the mineral allanite as a rock constituent. The chemical nature of this mineral was determined by an analysis by Hillebrand of material isolated from a biotite porphyrite of the Ten Mile District, Colorado. Crystals of an exactly similar nature were discovered in thin sections of all the more acid varieties of massive rocks from many widely separated localities.

Mr. W. G. Brown[3] gives an account of a quartz-twin found in the soil of Albermarle Co., Va., which closely resembles those long since described by G. Rose from Reichenstein in Silesia. The twinning-plane is, however, regarded by Mr. Brown not as R, but as $-\frac{5}{8}$R, as suggested by Naumann. The same writer[4] describes the occurrence and crystallography of the cassiterite from Irish creek, Rockbridge Co., Va.

Mr. Geo. F. Kunz[5] describes the native antimony and its associations at Prince William, York Co., New Brunswick. The antimony most commonly occurs in rounded or elongated masses having a compact, finely granular texture. More remarkable, however, are coarsely crystalline radiating masses consisting of blades four inches in length and one-eighth of an inch in width. Stibnite and kermesite are the only antimony minerals thus far observed associated with the native metal, although others doubtless occur.

[1] Amer. Jour. of Science, July, 1885, p. 58.

[2] Ib., Aug., 1885, p. 108.

[3] Ib., Sept., 1885, p. 191.

[4] Amer. Chem. Jour., Vol. VI, No. 3.

[5] Amer. Jour. of Science, Oct., 1885, p. 275.

BOTANY.[1]

The Growth of Plants watered with Acid Solutions.—In the September and October numbers of the American Naturalist for 1883, the writer published the results of an examination of the effects of watering, with acid solutions, growing plants of the silver-leaf geranium, and he there stated his intention of continuing his experiments in this direction by growing the same plant under similar or identical conditions upon siliceous, feldspathic and calcareous soils. These experiments were made in the summer of 1884, and the results obtained form the substance of this paper.

The conclusion seemed warranted by my previous experiments that the acids had a tendency to increase the ash or mineral ingredients of the plant, and this inference led me to suppose that if the soils used were highly mineralized the deleterious action of the acids upon the plant tissue would be diminished and at the same time the introduction into the plant of mineral substances increased. The soils were prepared and the plants potted about July 1st, the proportion of pulverized mineral in all cases being from twenty-five to thirty per cent of the whole, for the silica common cement sand was used, and the earth was taken from garden mold. The strengths of the acid solutions used were as follows: Of hydrochloric, nitric, sulphuric and carbolic 10^{cc} of the concentrated acid to one liter of water; of oxalic, tartaric, tannic, citric and formic 20^{cc} of the saturated solutions to one liter of water. Ordinary flesh-colored feldspar from granite veins in the gneiss rock of Manhattan island was powdered and used for the feldspathic tests, and dolomitic marble from Westchester county similarly treated and mixed in thoroughly with the mold to make a calcareous soil.

The tables following show the results obtained in all my experiments, including those of 1882. The first set of tables shows the state of leafiness of the plants at different times, and the second the percentage of ash with the weight of the dried plant at the end of the experiment.

Experiment of 1882 with garden mold for soil:

	June 25.	*July 13.*	*Aug. 24.*
Hydrochloric	6 full leaves	6 full leaves	5 full leaves
Nitric	5 "	4 "	2 "
Carbolic	4 "	2 "	none
Formic	4 "	6 "	5 full leaves
Salicylic	6 "	7 "	4 "
Sulphuric	7 "	5 "	2 "
Tartaric	7 "	9 "	9 "
Tannic	6 "	9 "	9 "
Citric	5 "	7 "	7 "
Water	11 "	13 "	17 "

[1] Edited by Professor Charles E. Bessey, Lincoln, Nebraska.

Experiments of 1883 with siliceous, feldspathic and calcareous soils:

SILICEOUS.

	July 5.	*July 22.*	*Aug. 16.*	*Sep. 1.*
Hydrochloric	5 leaves	5 leaves	5 leaves	4 leaves
Nitric	6 "	7 "	3 "	4 "
Carbolic	4 "	3 "	0 "	0 "
Sulphuric	4 "	4 "	0 "	0 "
Formic	5 "	6 "	5 "	4 "
Oxalic	5 "	7 "	7 "	6 "
Citric	4 "	6 "	6 "	4 "
Tannic	5 "	6 "	7 "	5 "
Tartaric	5 "	7 "	7 "	5 "
Water	4 "	7 "	6 " + fl.	5 "

FELDSPATHIC.

	July 5.	*July 22.*	*Aug. 16.*	*Sep. 1.*
Hydrochloric	5 leaves	6 leaves	5 leaves	3 leaves
Nitric	3 "	2 "	2 "	2 "
Carbolic	5 "	4 "	3 "	1 "
Sulphuric	4 "	4 "	0 "	0 "
Formic	5 "	5 "	4 "	5 "
Oxalic	3 "	5 "	6 "	6 "
Citric	5 "	7 "	8 "	6 "
Tannic	5 "	7 "	5 "	5 "
Tartaric	4 "	7 "	9 "	6 "
Water	4 "	5 "	6 "	5 "

CALCAREOUS.

	July 5.	*July 22.*	*Aug. 16*	*Aug. 22.*
Hydrochloric	4 leaves	5 leaves	3 leaves	2 leaves
Nitric	4 "	2 "	1 "	0 "
Carbolic	5 "	3 "	2 "	2 "
Sulphuric	4 "	2 "	1 "	0 "
Formic	3 "	4 "	5 "	5 "
Oxalic	5 "	7 "	5 "	6 "
Citric	4 "	5 '	7 "	7 "
Tannic	3 "	5 "	5 "	5 "
Tartaric	5 "	5 "	7 "	5 "
Water	5 "	7 "	7 "	7 "

The condition of the plants in these prepared soils varied materially from that of those grown in 1882 in garden mold. They were much more stunted and did not in the most favorable cases put out as many leaves as those of 1882.

The contrast, however, in leafiness between the plants watered with acids and those treated with water alone is far less marked in the artificial soils than in the case of the same tests in ordinary mold. The tables show this. In both experiments the inorganic acids and carbolic acid acted most deleteriously upon the plants,

while under the application of the dilute organic acids the plants maintained a comparatively vigorous growth.

The relative condition of the plants at the end of the experiment as compared with that at the beginning was nearly the same in both sets of experiments, viz., with the inorganic and carbolic acids they underwent a slow devitalization culminating in the death of the plant, or a very reduced state of health, while with the other acids they apparently resisted their weakening influence more successfully, and while not assisted were but slightly injured by their presence in the soil. The mineralized soils proved uncongenial for the plant, but in this case the plants watered with organic acids and those treated with water showed a very similar if not identical state of health.

However, the conjecture that in the mineralized soils the acid-watered plants would show an increase in ash over the water-plant seems confirmed by the following tables of the results obtained.

Experiment of 1882 with garden mold for soil:

	Wt. dried plant.	*Percentage ash.*
Nitric	0.536 grammes	16.79
Carbolic	0.5135 "	16.60
Formic	0.5535 "	18.15
Salicylic	0.5885 "	17.00
Tannic	0.6975 "	19.80
Tartaric	0.9325 "	14.74
Water	1.1615 "	19.11

Experiments of 1883 with siliceous, feldspathic and calcareous soils:

SILICEOUS.

	Wt. dried plant.	*Percentage ash.*
Hydrochloric	.904 ? grammes	19.46
Nitric	.932 ? "	17.36
Carbolic	.532 "	17.48
Sulphuric	.357 "	19.60
Formic	.683 "	20.05
Oxalic	.597 "	21.77
Citric	.521 "	20.92
Tannic	.729 "	19.82
Tartaric	.779 "	19.77
Water	.951 "	20.51

FELDSPATHIC.

	Wt. dried plant.	*Percentage ash.*
Hydrochloric	.6395 grammes	21.50
Nitric	.510 "	22.15
Carbolic	.904 "	14.93
Sulphuric	.400 "	22.00
Formic	.757 "	20.67

FELDSPATHIC.

	Wt. dried plant.		Percentage ash.
Oxalic	.7575	grammes.	19.09
Citric	.895	"	19.87
Tannic	1.233	"	16.22
Tartaric	.7875	"	18.92
Water	1.2115	"	16.01

CALCAREOUS.

	Wt. dried plant.		Percentage ash.
Hydrochloric	.677	grammes	19.35
Nitric	.543	"	22.30
Carbolic	.692	"	16.18
Sulphuric	.502	"	20.10
Formic	.512	"	22.85
Oxalic	.521	"	23.41
Citric	.783	"	20.24
Tannic	.5985	"	18.13
Tartaric	.732	"	19.26
Water	1.33	"	16.39

With the exception of the plants growing in the siliceous soil the other plants, putting aside the carbolic acid plants whose enfeebled condition barely permitted them to retain their vitality, show a markedly higher percentage of ash over that found in the water plants. It would seem as if the acids had dissolved to some extent the feldspar and dolomite, and permitted the plants to assimilate more of the mineral substances of the soils, but that this action in the siliceous soil had been prevented or retarded by the more insoluble character of its ingredients. Even in the latter instance they approach in their percentage of ash more closely to the water plant than in the experiment made with the unmineralized soil. The varying *special* details of the experiments should not in this connection be made the basis of any general conclusion, as unequal exposure to the flame in reducing the plant to ash gives rise to important differences in the weights of the residual salts. But it is apparently justifiable to conclude that the action of acid upon soil containing growing plants is to increase the mineral constituents of the latter, and that slightly acid waters percolating through a pulverulent soil richly provided with comminuted and impalpable matter would assist its introduction into plants needing these elements.

Professor Stockbridge, in a report to the Board of Agriculture of Connecticut in 1876, says that, "Every plant contains silica, potash, soda, lime, magnesia, phosphoric and sulphuric acids, chlorine and iron, and in order to have soils feed plants the material must be brought into such condition that the vital force can use it." This is of course obvious, and the slow corrosive action of terrestrial waters and falling rains in decomposing the mineral components of soils is doing that very thing. The experiments described and their results are a very exaggerated form of the nat-

ural processes prevalent about us. The plants, though injured in their growth and their consequent powers of absorption, by the quite acid solutions used, showed as high and *higher* percentages of mineral matter in the ash as did the water-fed plants which were unimpeded in their nutritive processes by an injurious treatment. Experiments may now be undertaken upon phosphatic (insoluble phosphate) soils with the same means.—*L. P. Gratacap, New York City.*

Botanical News.—Papers on the following subjects occur in the later numbers of *Annales des Sciences Naturelles*, viz., Characters of the principal families of Gamopetalæ drawn from the anatomy of the leaves, by Julien Vesque; The dissemination of the spores of vascular Cryptogams, by Leclerc du Sablon; Notes on some new or little-known parasitic Fungi, by V. Fayod. In the latter are noticed *Endomyces parasiticus* Fayod, a new species parasitic on the gills of *Agaricus rutilans; Peziza mycetophila* Fayod, another new species parasitic on *Agaricus vellereus;* and *Hypomyces leotiarum* Fayod, parasitic on *Leotia lubrica.*——Late numbers of *Flora* contain the following articles, viz.: New Lichens of Bering's straits, by W. Nylander; New North American species of Arthronia, by W. Nylander; The opening and unrolling of fern sporangia and anthers, by J. Schrodt.——In the last *Hedwigia* Professor Oudemans describes a new species of rust, *Puccinia veronicæ-anagallidis.*——The September *Journal of Mycology* is devoted wholly to a description of the North American species of Glœosporium, forty-seven in all.——In *Grevillia*, M. C. Cooke describes a large number of new British Fungi; and Cooke and Plowright describe twenty California Fungi, including one interesting rust, *Uromyces puncto-striatum*, on twigs of Rhus.——The *Journal of Botany* for September contains a valuable paper on the caulotaxis of British Fumariaceæ, by Thomas Hick; A list of European Carices (151 species), by Dr. H. Christ; and a Classification of garden roses, by J. G. Baker, in which sixty-two species are recognized.——Late numbers of the *Botanische Zeitung* contain papers by Arthur Meyer on the Assimilation-product of the leaves of angiospermous plants, and by Solms-Laubach on the Sexual differences of fig trees.——The most important botanical articles in the September *Gardeners' Monthly* are, The destruction of trees by coal gas, by H. F. Hillenmeyer; The curl in the peach, and The age of yew trees.——Late numbers of the *Gardeners' Chronicle* contain a review of the genus Odontoglossum, by James O'Brien (accompanied with many wood-cuts); a notice of the Chelsea Botanic Garden; The cross-breeding of cereals; Disease and decay in fruit, by W. G. Smith; a notice of the life of Dr. Regel, the venerable director of the Imperial Botanic Garden of St. Petersburg; a description of a new Brazilian species of Aristolochia (*A. elegans*); figures and descriptions of *Peronospora pygmæa* and its resting spores.

ENTOMOLOGY.

On the Parasites of the Hessian Fly.[1]—The paper consists of a digest of a communication on the same subject now in press in the Proceedings of the U. S. National Museum. It gives the synonymy of *Merisus destructor* (Say), showing the difficulty that has been encountered in the past in properly locating it generically. It then reviews what was known of the habits of the species by earlier authors and, on account of the insufficiency of previous descriptions, gives a full and detailed description. The descriptions of Herrick, Fitch and Packard are shown to refer to this species rather than to any other so far known. The species never occurs in the apterous condition.

Merisus (*Homoporus*) *subapterus*, n. sp., is then described and separated from *destructor*, the wingless specimens referred to by Say and Herrick under this last species being considered as belonging to *subapterus*. *Subapterus* is exceptionally winged. *Destructor* is, on an average, of smaller size, more uniformly metallic in color; has a flatter abdomen with yellowish spot at base; has the antennæ similar in both sexes and either pale brown or blackish brown; has the coxæ metallic black, the femora brown or black except towards tip, the paler parts of the legs whiter than in *subapterus*, and does not, so far as we now know, occur in the apterous condition.

Subapterus is, on the average, larger; of darker color and less metallic, with the flagellum of the antennæ pale in the male and black in the female; the abdomen much more rounded and without the pale spot; the coxæ, trochanters, femora and basal part of tibiæ honey-yellow. It occurs mostly in the wingless condition.

The paper next treats of *Eupelmus allynii* French, showing that it is parasitic on both *Isosoma hordei* and *I. tritici*, as well as on the Hessian fly. The polyphagic habit of this genus is then shown, and the experience of the author is given in breeding species from Lepidopterous eggs, from Orthopterous eggs, from Hemipterous eggs, from Cynipid galls, from Lepidopterous larvæ, from Coleopterous larvæ and from free Cecidomyid larvæ.

Tetrastichus productus, n. sp., is described and the inference drawn from the habits of the genus that it may be a secondary parasite.

Platygaster herrickii Packard is then treated of with the conclusion that *P. error* Fitch is parasitic on some other insect and not on the Hessian fly. The statements of both Herrick and Professor A. J. Cook are then considered in reference to the oviposition of this species in the eggs of the Hessian fly. The author, while disinclined to oppose direct observations when asserted, even

[1] Abstract of a paper read before the Am. Ass. Adv. Sci. at Ann Arbor, by C. V. Riley.

when such conflict with all that has before been known or with previously uniform unity of habit, still feels that the observations need verification, and that it is probable that both Herrick and Cook mistook the young Hessian fly larvæ for the eggs.

Another species of Tetrastichus to which Professor S. A. Forbes has given the MS. name of *carinatus*, is briefly referred to as being in all probability a secondary parasite, and a single Microgaster is mentioned but not described, as some doubt exists as to whether it is parasitic on the Hessian fly, although it was bred from straw infested by this last.

FORBES' REPORT ON THE NOXIOUS INSECTS OF ILLINOIS FOR 1884. —Professor Forbes' third report abounds in new matter of interest both to the entomologist and the agriculturist. Besides the new Crambus feeding on the roots of the corn, two leaf-rolling moths are described, as well as the corn aphis, with notes on other corn insects. Among the wheat insects there are fresh contributions to our knowledge of the Hessian fly and its parasites, the facts ascertained strongly suggesting the hypothesis of a normal completion, before harvest, of the transformation of a considerable part of the destructive spring brood of the larvæ. Three new parasites are described, viz: *Pteromalus pallipes*, *Pt. fulvipes*, and *Tetrastichus carinatus*. The wheat midge is re-described in all its stages and new observations on its habits are presented. Several pages are devoted to the grass worm (*Laphygma frugiperda*), some clover insects are described, as well as insects injurious to the smaller fruits, as the apple and pear, and some shade trees. Though the report is a somewhat miscellaneous one it contains considerable novel matter. Many of the illustrations are unequal and some are not so good as they should be, probably from lack of means afforded by the State authorities, and the lack of first-class artists. The appendix is exceedingly useful, as it contains general indices to the first twelve reports of the State entomologists of Illinois, the plant index being particularly useful.

FLIGHTS OF LOCUSTS IN EASTERN MEXICO IN 1885.—Much destruction resulting from the presence of great swarms of locusts were reported in the newspapers in Eastern Mexico in September of the present year. While at Cordova, in March last, I was told by Mr. L. H. McCormick, of Chicago, who was then on his way to Vera Cruz from the City of Mexico, that he witnessed a flight of locusts between Esperanza and Orizaba on March 24th. They made the sky dark, and were of the size of our large grasshoppers. I may add that during a month's sojourn in Mexico I did not see any locusts, not even along the stage road from Saltillo to San Miguel. The swarms must be quite local, and originate in the *tierra caliente*, or tropical zone of Central America, south of Mexico.

From Dr. A. A. Russell, of Cordova, to whom I was indebted

for much kindness during a short stay at Cordova, I obtained the following information regarding the destructive locust of that region. Within the last two or three years locusts have devastated portions of Central America, and for two years past they have extended over nearly the whole of the States of Vera Cruz, Oaxaca, Chiapas, Morelia, Michoacan and the intervening country to Matamoras. Dr. Russell lost perhaps $3000 worth of coffee trees on his plantation, and in a single year spent nearly $1000 in fighting locusts.

According to his statements the swarms of locusts arrive from Central America over a period lasting from April to November, viz., from seed time to harvest. They deposit their eggs in April and May, the young hatching in from twenty to thirty days, and becoming fledged in three months. The young locusts do the most harm, and travel in dense masses, sometimes six inches deep, leaving the ground behind them black, as if burned by fire. They are often so thick in the roads that the horses will slip and slide over their crushed bodies. They are particularly destructive to the young coffee plants, gnawing off the bark from the young trees and from the tender branches of large trees, but they do not eat the leaves. Oranges, palms, corn, rice and tobacco plants also greatly suffer from the attacks of this locust. Unfortunately no specimens could be obtained so as to learn which species does this wide-spread damage. It is probable that the insect is *Acrydium americanum*, as we have received specimens from Yucatan. For other accounts of the ravages of locusts in Central America and Mexico, see first report of the U. S. Entomological Commission, pp. 460–465; also third report, appendix, p. 60.—*A. S. Packard.*

Chinese Insect White Wax.—At the last meeting of the British Association, Mr. A. Hosie read a paper on "Chinese insect white wax," in which he stated that, although the province of Szu-chuan, in Western China, where he had been stationed for the last three years, was the chief wax insect and wax-producing country in the empire, insects and wax were found in other provinces. Mr. Hosie was called upon by the Foreign Office to collect for Sir Joseph Hooker specimens connected with, and all possible information on the subject of this industry, and the present paper was a revision, with additions, of a report already published in a Parliamentary paper in February last. He described the insect-producing country, the tree on which the insects were propagated, the insects themselves, and their transit from the valley of Chien-chang, their breeding ground, in the west of Szu-chuan, across the mountains to Chiating Fu, the habitat of the wax tree. The tree was then described, and details were given of the treatment of the insects, their suspension on the trees, the depositing of the wax, and of a parasite on the insects. The method of re-

moving the wax from the branches of the tree and of preparing it for market was then explained. Thereafter Mr. Hosie detailed the result of an examination of the insects after the wax had been fully deposited, and finally passed to the annual quantity of insect white wax produced, its value and uses.—*English Mechanic.*

Palpi of Insects.—Examination of above fifty individuals of diverse forms of Orthoptera and Coleoptera have caused M. F. Plateau to reach the following conclusions respecting the use of the palpi: (1) During the act of eating they remain inactive. (2) Deprivation of the maxillary palpi does not hinder the insects from eating as usual. (3) Loss of the labial palpi has no more effect. (4) Smell remains the same after the four palpi are taken away. (5) The amputation of all the palpi does not prevent these insects from recognizing and seizing their food. (6) Loss of all the palps does not prevent them from feeding as usual.

Entomological News.—We have received from Dr. G. Mayr a detailed work on fig insects, consisting of 105 closely-printed pages, with three excellent plates.——Dr. J. A. Lintner, the State entomologist of New York, has issued a lecture on cut-worms, read before the State Agricultural Society in January last.——One of the most valuable contributions to entomology of the year is Mr. Poulton's "Farther notes on the markings and attitudes of lepidopterous larvæ, together with a complete account of the life-history of *Sphinx ligustri* and *Selenia illunaria*," in the second part of the Transactions of the Entomological Society of London, for 1885. Among the topics discussed in this paper are the following: The utilization of the changes in color before pupation for protective purposes, and an anatomical reason for the special protection of larvæ, wherein the author shows that the various means of protection in larvæ are always of a passive kind. When active (flagella) they seem to be directed against the attacks of ichneumons, which produce fatal results in quite another way. "Nearly all the means of defence against other enemies are such as tend to prevent the larva from being seen or touched, rarely such as to be of any avail when actually attacked." This Society has within a few months obtained a royal charter.——The death of Mr. H. K. Morrison, so well known as a zealous and successful collector, in May last, was sudden. There is a good opening for one or more efficient collectors in this country to succeed Belfrage, Boll and Morrison.

ZOÖLOGY.

Recent work on Balanoglossus.—W. Bateson[1] has recently investigated the morphology of Balanoglossus, and thrown a great deal of light upon this hitherto obscure and little understood animal. A summary of his results is as follows: There is

[1] Quarterly Journal Mic. Soc. Suppl., 1885.

a spherical gastrula, large circular blastopore, later the body is elongated, the blastopore closes completely, a ring of strong cilia forms about the blastoporic area, the blastopore being placed eccentrically in the ring. The body becomes constricted by a transverse ring, a second forms behind it, and the body is thus cut off into three regions corresponding with the future proboscis, collar and body portion; the end of the proboscis is furnished with a tuft of cilia. A groove forms in the middle line of the dorsal region of the collar, and at the same time the dorsal nerve cord is delaminated from this ectoderm. At the same time a pore perforates the skin behind the collar on either side, placing the endoderm and the ectoderm in communication, and furnished with cilia, it is the first pair of gill slits. The mouth forms in front of the collar at the base of the proboscis, and later the anus arises at the opposite end of the body. In the species whose life-history is dealt with in this paper, viz., *Balanoglossus kowalevskii*, the development in the external form proceeds by the direct growth from the form now arrived at to the adult by the elongation of the body, the addition of the gill slits and the differentiation of the body region into the branchial and digestive portions, and the disappearance of the ring of cilia and the tuft of cilia upon the proboscis. There is thus no Tornaria stage included in the life-history of *B. kowalevskii*, but the development is direct. Bateson does not discuss the question of the relations between the echinoderms and Balanoglossus, reserving it for the fuller discussion that is promised in a future paper.

The history of the internal changes is briefly as follows: The endoderm was invaginated, as seen from the surface; from it arises the mesoblast in three separate masses, one anterior unpaired mass in the proboscis, two anterior lateral masses, two posterior lateral masses. These all arise as diverticula of the archenteron, and their cavity, at first continuous with that of the primitive gut, becomes the various portions of the body cavity. A forward proliferation on the dorsal side of the gut wall, with at first an opening into the gut cavity, gives rise to a solid supporting organ which runs from the collar region into the proboscis, and is the homologue of the notochord of the Chordata. The walls of the anterior unpaired body cavity is produced backward as two horns, the left comes to open to the exterior by a pore in the proboscis, the right lines the body cavity of the proboscis. The anterior pair of diverticula becomes filled almost completely, and the posterior pair form the most of the cavity of the body. In the collar region the edge of the collar posteriorly overhangs the body wall to such an extent as to partially close in a cavity there, open behind, in which the first pair of gills lie, this space is called the atrial cavity. A duct arises in a thickening in the wall of this space, and places the cavity in communication with the body cavity of the collar. Nothing is yet determined in regard to the generative system.

Balanoglossus presents resemblances, though with some difference, to Amphioxus in the following points: Origin and persistence of the notochord and its relation to the alimentary canal, position of the blood-vessels of the gills and the form of the gill bars, position and mode of origin of the central nervous system, origin of the mesoblast and body cavity, the atrial fold and the duct from body cavity into the atrium—similar to the excretory tube of Amphioxus.

The complete discussion of the affinities of Balanoglossus is reserved for a future paper, but Bateson proposes to associate it as follows:

Hemichorda	=	Enteropneusta
Urochorda	=	Ascidians
Cephalochorda	=	Amphioxus
Vertebrata.		

—*Henry Leslie Osborn.*

THE REPRODUCTION OF THE COMMON MUSSEL.—Professor W. C. M'Intosh describes the reproduction of the mussel (*Mytilus edulis*). The sexes are distinct in the adult form, but in the undeveloped condition the structure of the organs seems to be similar in both sexes. The shape of the valves gives no reliable distinction. The reproductive elements are developed in the mantle; the male presents in January, in the thickened generative region of the mantle, large pale round sperm-sacs filled with minute spermatozoa, which have minute ovoid bodies with finely filamentous tails. They are lively and tenacious of life. Twenty-four hours of exposure, however, seems to be fatal to them. The females have the same region of their mantle crowded with a prodigious number of minute ova. Throughout February the development increases, and the whole surface of the mantle becomes speckled in both sexes with the reproductive elements. After full maturity is attained, as in April, the orange mantle is richly marked in an arborescent manner by racemose sperm-sacs and ducts, especially towards the margin. In the females this is not so evident, the ova being grouped in masses and densely packed.

From this time the activity of the spermatozoa and the number of the ova diminish, till in July neither ova nor spermatozoa can be distinguished microscopically.—*Journal of the Royal Microscopical Society, June, 1885.*

MANNER IN WHICH THE LAMELLIBRANCHS ATTACH THEMSELVES TO FOREIGN OBJECTS.—Dr. J. T. Cattie describes the means by which the common mussel attaches itself to foreign objects. When the foot commences to grope about, it may become two or three times as long as the body of the animal without finding any object within its vicinity; it then moves about till it finds some point of support, when this is effected there appears from the transverse cleft which terminates the ventral groove a whitish sub-

stance which gradually becomes more opaque; sometimes the slit takes on the form of an equilateral triangle, and then the quantity of matter which exudes from it is greater; this matter obviously comes from the cylindrical tubes which are scattered in the glandular substance of the foot. A terminal plate having been formed the foot is withdrawn, and the plate and the byssus are merely connected by a delicate thread. The time necessary for an animal of average size to form the plate varies between 55 and 90 seconds; in some cases two connecting threads become developed. The terminal plate, when studied under the microscope, was found to be formed of thousands of small granules, irregularly distributed, and varying considerably in size. The fine threads appear to be formed by the agglutination of granules of various sizes, but large granules are formed by the fusion of several smaller ones.

The formation of the byssus is regarded by the author as being very simple; the walls and the lamellæ of the byssus-cavity continually secrete a byssogenous matter; the lamellæ in the anterior and narrow part of the cavity unite and fuse with one another, while the narrow shape of the orifice gives the byssus-threads their form. Owing to the relations of the ventral groove of the foot each byssus-thread is immediately fused to the main trunk.

The author doubts the correctness of A. Müller's view that there is an agglutinating and a byssogenous substance; and speaks severely of the artificial character of that author's classification of the species.—*Journal of the Royal Microscopical Society, August, 1885.*

Pulmonate Uropneustic Apparatus.—H. von Ihring[1] writes upon the morphology of the lung cavity in the Helicoidea. While in Cyclostoma, also in the Limnæida, the lung is plainly a modified gill cavity and still contains in the adult, in some form, the rudiment of the gill, in the Helicoidea the lung is not at all the remains of an old mantle cavity, but is a special cavity formed by a dilatation of the duct leading from the excretory organ to the exterior, and the breathing pore occupies precisely the place occupied by this orifice in the opisthobranchs. Semper had differed from von Ihring upon this, and claimed that the lung was a modified gill cavity, so von Ihring made observations upon a number of forms, among them Onchidium and Vaginulus. These he concludes to be the lowest forms in the Helicoid phylum, forms from which the helicoids have been derived, and further forms which, derived from marine ancestors, have been adapted to an amphibious habit and given rise to descendants wholly air-breathing. There is in Onchidium not the slightest trace of a gill in the lung cavity, and this is situated at the end of the meter. This paper opposes the view of Borgh that Onchidium is a pul-

[1] Zeitsshr. f. w. Zool. 41, p.259, 1885.

monate adapted from a terrestrial to an amphibian mode of life. —*Henry Leslie Osborn.*

HELIX CANTIANA AT QUEBEC.—Few accessions from abroad to our lists of land shells having lately been recorded, the discovery in Canada of a large colony of a foreign species, not previously known to occur on this continent, is of more than ordinary interest. When at the ancient capital recently, in ascending the steps from Dufferin terrace to the citadel, I stopped to recover breath on a stage considerately provided for such purposes, at a point at about thirty feet from the summit of the glacis. From this resting place a path, trodden only by goats and equally sure-footed Quebec gamins, leads upward in a westerly direction along the steep and narrow slope between the south walls of the citadel and the almost perpendicular rock on which it stands. Noticing a small helix moving on the path, I passed under the guard-rail and ventured out upon it, not indeed wholly without fear, as there was danger, in case I slipped, of falling into Champlain street, four hundred feet below. The shell, which proved to be *Helix rufescens* Pennant, was found in abundance, in company with numerous *Limax agrestis* L., clustering around the roots and climbing the stems of a tall, rank weed, apparently a species of Ambrosia. An occasional specimen of a larger shell, which I supposed to be immature *H. hortensis*, was also found at intervals along the path; and directly above where Montgomery fell, it occurred in considerable numbers in scattered clumps of grass which had obtained a foothold on the shaly cliff. It seemed strange to me that among the many shells no mature *H. hortensis* could be observed; but thinking it could be no other species, I was content with collecting about a dozen specimens, though I might readily have obtained hundreds; and picking my steps carefully back to the point of departure, gave the shells no further thought until after my return to Ottawa. When preparing the *H. rufescens* for the cabinet, I examined with more care than previously the associated shell, and surmising that, instead of immature *H. hortensis*, it was *H. cantiana* Montague, proceeded to compare it with specimens of the latter species received some years ago from Mr. Hey, of York, England, and with the description and figure given in Jeffreys. The comparison at once removed all doubt of the identity of the Quebec shell. It lacks in general the rufous concentric line conspicuous on the body whorl of the English specimens of *H. cantiana*, and is somewhat smaller; but has the reddish band around the aperture, and is in every other respect the same. I have described the locality in which it is found with some minuteness, in order that visitors to Quebec may obtain specimens, if they think it worth the trouble. I might add that it was a warm, moist evening when I found the shells.—*Frank R. Latchford, Ottawa, Ont.*

Rats nesting in Trees.—In the neighborhood of New Almaden, Santa Clara county, Cal., I observed, during August of this year (1885), that in many of the small oaks there were masses of twigs, some of the masses as large as a bushel measure. On examination I found that each of the twigs showed evidence of having been gnawed off by some rodent. These nests proved to be inhabited by a species of rat about the size of the domestic rat, but finer looking, and with larger ears. They probably belong to the genus Neotoma of Say and Ord. The rat that builds a conical nest on the ground, of twigs and branches to the heighth of two or three feet, is probably of the same species as this living in the trees, as I found the nests of the two near together, and sometimes a nest would be half on the ground and half in the tree. —*H. W. Turner, U. S. Geol. Survey.*

Preliminary note on the Origin of Limbs.—From my studies on the limbs of vertebrates I get the following results:

1. There exists no "homodynamie" between the skeleton of the gills and the limbs (Thatcher, Mivart, Balfour, v. Rautenfeld, Dohrn).

2. The original form of the paired fin is like that of the unpaired, and consists of parallel rays vertical to the axis of the body on a horizontal plane (Thatcher, Mivart, etc.).

3. These rays unite proximally to form the *basipterygium*, which turns out, forming the posterior border of the fin, the *metapterygium* (Balfour).

4. The extremities of the higher vertebrates have originated directly from the fin by a rotation of the latter through 180° in the direction of the hands of the clock.

5. The extremities of the higher vertebrates have originated by reduction of the propterygium and mesopterygium and the following rays of the metapterygium.

6. A line drawn through humerus, radius, radiale, carpale$_1$, metacarpale$_1$, digit$_1$ in the urodelous batrachians corresponds to a line along the basipterygium, or the first ray of the metapterygium.

7. The oldest known extremities of the higher vertebrates are seen in the Menopomidæ, in Salamandrella and Ranodon, among the batrachians (two central bones), in Plesiosaurus, Pliosaurus, Baptanodon (Sauranodon, rudiments of ulnar rays [" olecranon"]). A fact of great interest is the presence of *two central bones* in *the carpus of the Rhynchocephalia* (Hatteria, Proterosaurus) never observed before.

8. The reduction of radial rays in the higher vertebrates is a secondary condition produced by the adaptation to a terrestrial life.—*Dr. G. Baur, Yale College Mus., New Haven, Conn., Oct. 2, 1885.*

Zoological News.—*Protozoans.*—Dr. R. Blanchard (Bull. de la Soc. Zool. de France), in an article modestly entitled, "Note sur le Sarcosporidies," gives the history of our knowledge of these parasites from their first discovery by Miescher in the muscles of a mouse to the present time, and presents an essay upon their clasification. These Sporozoa or Sarcosporidia are intimately related to Coccidium and especially to Klossia. They have been found in the mouse, the pig, the horse, the ox, the sheep, the dog, the cat and the rabbit, and more rarely in those of man. Virchow has noticed that they produce no change in the muscular tissue. As they occur in the ape, it is clear that man is not safe from them, and Lindemann has described them from the valves of the human heart. As they enter the system by the digestive canal, the practice of cookery explains their comparative rarity in man.——At the Académie de Sciences of Paris, M. A. M. Edwards presented a note of M. de Folin, relating a curious form of reticulated rhizopod which inhabits what seems to be small pebbles in hardness and aspect. The organism forms a sort of paste of foreign particles and sarcode and covers the whole with a secretion like that which forms the test of a porcellanous foraminifer, and is not only smooth, polished and shining, but colored in many tints. These foraminifers form the genus Lithozoa, with numerous species.——M. R. Blanchard has described a peritrichous infusorian ectoparasite of fresh-water fish. *Apiosoma piscicola* is fixed during its whole existence.

Worms.—The thesis of M. J. Porrier for degree of doctor of the faculty of sciences at Paris, has for its subject the trematodes. The structure of the skin, and the anatomy of the suckers are thoroughly treated, and details noted which need figures to be understood. The most interesting fact in relation to the digestive tube is the description of the absorbent hairs. The ciliated sac which surrounds the prostate gland and seminal receptacle seems to serve only to protect the prostate and plays no part in copulation. The canal of Laurer also, once considered a copulatory organ, is but a reservoir, so that the only probable and admissible mode of fecundation is external self-fecundation, such as Sommer admits for the cestodes. M. Porrier has also collected facts of importance relative to the structure of the nervous system.——M. Remy Saint-Loup describes a new marine oligochete, many characters of which are analogous to those of Pachydrilus Claparede, but which is transitional between that genus and Enchytracidæa.——An examination of some tunicates collected by various arctic expeditions have been made by C. W. S. Aurivillius, in order to discover crustacean parasites. Two amphipods, *Andania pectinata* and *Aristias tumidus*, were found, together with nine copepods, six of which were new. Out of four of these our author makes two new families. As a rule a parasite seems to affect a single genus or even species.

Reptiles.—M. Le Vaillant has described a new species of land tortoise, *Testudo yniphora*, captured in or near the Comoro isles by some Arab sailors. Its carapace is highly convex, or hemispherical, the anterior and posterior apertures but slightly elevated, recalling those of *T. radiata*. The plastron has a peculiarity which enables it to be distinguished at sight from all other tortoises, and is the motive of the name given to it. In color the back is reddish-yellow with brown on the periphery of the plates, while the plastron is pale yellow.

Mammals.—An example of *Kogia breviceps*, the pigmy sperm whale, was taken in 1884 at Spring Lake, N. J. This was the first time that this rare species had been taken in the Atlantic. The specimen, like the majority of those hitherto taken, was a female. The Smithsonian Institution has just received a specimen of a male of this species, taken at Kittyhawk, N. C. Mr. True states that it is about nine feet long and apparently adult. Near the anterior end of the upper jaw are four slender curved teeth, similar to those of the lower jaw, but smaller. Two teeth are said to occur in a similar position in a specimen from India, described by Sir R. Owen as *Euphysetes simus*. The genital opening is situated anterior to the line of the front margin of the dorsal fin. The stomach contained only the beaks and eyes of cuttlefish and a great quantity of nematoid worms. A large quantity of cestoids, apparently Phyllobothrium, were found encysted in the teguments of the back, especially about the dorsal fin.——The distribution in height of the mammals around Kilimanjaro is interesting. *Cercopithecus pygerythrus* was found at an elevation of 5000 feet, and the guereza, which is very common round the base of the mountain, at 3000 feet; the lion does not ascend beyond 3000 feet, but the leopard is very common up to 7500 feet. *Genetta tigrina* occurs up to 7000 feet, and *Herpestes caffer*, though not a mountain animal, ascends as far as the village of Moshi (5000 feet), as does also *Canis lateralis*. *Hyrax brucei* reaches 10,000 feet; the elephant 13,000, while the buffalo, the koodoo and a Neotragus attain to 14,000 feet above the sea. *Equus burchelli* and *Rhinoceros bicornis* do not ascend beyond 2300 or 2400 feet.——The Proceedings of the Zoölogical Society of London (Part II, 1885) contain a valuable article upon the anatomy, classification and distribution of the Arctoidea, by St. George Mivart. The genera are taken up separately, and the habits, distribution, external appearance, dentition, skeletal characters and proportions of each are carefully described. The classifications of Turner and Flower are given, and the article concludes with the author's arrangement, which differs from that of Flower as follows: Ailuropus is removed from the Ursidæ and placed with Ailurus in the section Ailurinæ of the Procyonidæ. The entire Arctoidea thus fall into the three families Procyonidæ, Mustelidæ and Ursidæ.——Dr. J. Struthers

(Jour. Anat. and Phys., January, 1881) gives the result of an examination of the bones, articulations and muscles of the rudimentary hind-limb of the Greenland right whale. Ten sets of these parts were dissected. The synovial capsule of the knee-joint, the acetabular cartilage, a synovial cavity and head of the femur are present, and an apparatus of strong ligaments is attached to the femur, permitting and restraining movements in certain directions. But these movements of the femur are limited, and in two examples the hip-joint was anchylosed without trace of disease. The muscles of these bones may be arranged in four groups, three of which connect them with other parts: (1) Internally with the genital organs; (2) a posterior or caudal mass; (3) an anterior or trunk mass; while the fourth connects the bones to each other.——According to Mr. P. L. Sclater, the wild ass of Somaliland is a new species, or at least subspecies, and is distinguished from that of the Nubian desert by its generally paler and more grayish color, the entire absence of the cross stripe over the shoulders, the very slight indication of the dorsal line, and the numerous black markings on both front and hind legs. It has also smaller ears and a larger and more flowing mane.——Mr. W. Leche (Proc. Zoöl. Soc., 1884) describes some Chiroptera from Australia, including the new species *Nyctinomus petersi* and *N. albidus*. In the latter species the ears are much larger than the head, and are united by a low band.——Mr. J. W. Clark describes (in the Proc. Zoöl. Soc.) a series of stuffed sea-lions belonging to the Australian Museum, Sydney, and from a study of these and other examples concludes that *Otaria cinerea* is "one of the four distinct species of Otaria inhabiting the Australian coast."——M. Fernand Lataste contributes to the Proc. Zoöl. Soc. for 1884, a description of a new species of Meriones, *M. longifrons*, from Arabia, together with a full account of its habits, intelligence and sexual relations. Gestation normally lasts twenty days, and the ovarian period about ten days.

EMBRYOLOGY.[1]

THE ARCHISTOME-THEORY.—The new doctrine of development, of which it is proposed to give a brief and partial sketch here, rests in part on a hypothetical basis and in part upon a well established theory founded upon observation. It consists further in an expansion and adaptation of the gastreal-theory of Haeckel in the light of more recent research, and a reconciliation of it with the deductions of His, Rauber, Whitman and myself, as to the occurrence of concresence of the lips of the blastophore and the differentiation of the axis of the body of the embryo from behind forwards, generally of bilateral types with paired mesoblastic sacks derived

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

directly or indirectly from the archenteron. It is also assumed with Sedgwick[1] that the most primitive form in which an imperfect approach towards the differentiation of a body-cavity is evident, as paired pouches of the archenteron, still opening into the latter, is seen in the bilaterally differentiated Actinozoa. It is further assumed that this modification of the archigastrula, as the primitive gastrula may be called as defined by Haeckel, is the first intimation which we have in any existing type, permanently represented in the ascending scale of morphological differentiation of organisms, of the permanent assumption of bilaterality. It is also assumed with Sedgwick that the mouth of such a form was elongated in an antero-posterior direction, thus leading to the differentiation of a permanent mouth and anus at the opposite ends of the original slit-like mouth of such a form. The circumoral band of sensitive tissue is also assumed to have given rise to the median nervous system of Chordata and Achordata. In the former median concrescence of the originally paired cords has been complete, and in the latter incomplete, so as to give rise to circumoral and circumanal nerve rings and a pair of ventral ganglionated cords. It is thus made obvious that I assume in a general way that the hypotheses propounded by Sedgwick are supported by a very large body of evidence and enable us to interpret and reconcile with great readiness the conclusions of biologists in reference to the development of other structures, especially the excretory, generative and appendicular organs. The evolution of the first two, the trachea of insects, the branchiæ of various forms, abdominal pores, muscular somites, etc., has been more or less fully discussed by Sedgwick himself, but the probable source and genesis of the limbs and appendicular organs he has hardly more than alluded to. To this part of the subject and the nature of the gastrula of bilateral forms I shall therefore especially address myself, and I hope greatly expand and further emphasize the views of Balfour's very worthy successor.

The antero-posteriorly elongated primitive gastrula mouth or blastophore of bilateral forms is assumed to have become secondarily elongated, either by a direct and obvious process of median concresence of its lips, as in Clepsine, in fishes, in Peripatus and arthropods generally, or this has become greatly obscured, as in Balanoglossus, Branchiostoma, Chætopoda, Chætognatha and some of the higher chordata and in certain degenerate types, as a result of secondary modifications which have immediately affected the primary sequence of events in the development of the neural plate or medullary groove. I therefore assume, in effect, that the medullary plate in all forms has been primarily formed from the concresced lips of an elongated blastopore, and this has in the

[1] On the origin of Metameric Segmentation and other morphological questions. Studies from the Morph. Laboratory in the University of Cambridge, II, 1884, pt. I, pp. 77-116, pls. x and xi. Also in Quart. Jour. Mic. Science, 1884.

lower forms been very generally perforated in the median line anteriorly to form the permanent mouth, and posteriorly to form the anus. The secondary modifications which have affected this mode of development of the permanent openings into the enteron depend, apparently, in large part upon a change in the aspects of the body, especially in the chordata in which the permanent mouth and anus are both new developments and do not coincide with the mouth and anus of primitive Bilateralia.

The primitively elongated mouth of the larvæ of Bilateralia, with an extended body-axis, or any derived form of the latter, or wherever there is formed a well-defined, unpaired median neural plate, or where a pair of parallel neural plates or cords are developed, I would call the whole area thus embraced an *archistome*. In the higher forms this archistome would be coëxtensive with the neural groove antero-posteriorly, as far forward as the pineal body, and as far backward as the true secondary blastopore, and even beyond it, when a primitive streak was formed by the concresence of the limbs of the blastoderm behind the posterior end of the axis of the embryo. In other words the archistome would extend from the pineal body in chordate embryos along the whole length of the embryonic axis through its blastopore and on through the primitive streak to the point where the yolk-blastopore closed. If the archistome were, therefore, to remain open, it would present the appearance of a cleft dividing the embryo into two symmetrical halves through the median line, and would extend even through the aborted portion of the lips of the primitive blastopore when a very long primitive streak was developed. It is thus rendered evident that I do not regard the unmodified, round gastrula-mouth, as understood by Haeckel, as always representing all of the blastopore in higher forms. According to this view the original gastrula-mouth is in fact greatly elongated as a result of growth in length, in consequence of which bilaterality becomes established, and of which we have the first hint in the Actinozoa. This is further intensified by development from before backwards, since, without exception, the elongate Bilateralia differentiate the cephalic end of the body in advance of the caudal. In confirmation of the foregoing views I would refer the reader to the existing special memoirs on the development of the primitive grooves and blastoderms in the fishes and arthropods (Tracheates especially).

Furthermore, the phylogeny of the mesoblastic somites is absolutely untraceable to any other source except to the gut pouches of a bilateral type approximating the Actinozoa, and whether the process has been abbreviated in arthropods or not, we are at least certain that in some primitive Chordata, the Teleostei, for example, the proof that the mesoblastic somites of the body grow from the concresced lips of the blastopore are so conclusive as to be incontestible. The way in which the mesenteron arises, and

the manner in which the primitive cumulus is formed at the germinal pole of blastodermic vesicle of Arthropoda indicates, it seems to me, taking into account the fact that the mesoblast is split off from the lower side of the neural plate, that the mesoblastic somites are here formed in essentially the same way as in the Chordata. The invagination or folding in of the germinal area, in insect embryos to form the amnion, at first posteriorly and at the sides, or according to the plan just the reverse of what holds in the formation of the amnion in the endocyemate types of Chordata, is to me conclusive proof that concrescence of the lips of the primitive elongated blastopore, or archistome, has taken place; for, in order to effect this sort of an invagination of the embryonic area the head end must for a time remain fixed, while the tail, continuing to grow in length, is thrust into the yolk, as in Calopteryx, carrying the amniotic limb of the blastoderm before it. It also seems that paired cavities soon appear in the mesoblastic somites underlying and derived from the epiblast, as above described in arthropods. I therefore see no very essential difference in the method of development in the two types. In both it is obvious that a portion of the archenteric walls of the elongated archistome has given rise to the mesoblastic somites, by a process which differs in no respect from, but agreeing even in its abbreviation with that which takes place in Branchiostoma directly from the sides of the archenteron.

We now come to the consideration of the most important part of the archistome-theory, namely, that portion of it which deals with the genesis of the limbs and their musculature. The readiness with which the view that the tentacles of an actinozoan ancestral form gave rise to the integument and musculature of the paired limbs of the Bilateralia is reconcilable with all the facts of embryology, is very remarkable. As is well known, the tentacles of Actiniæ consist of an outer layer of epiblast into which a hypoblastic lining is thrust from the paired lateral gut-pouches. If the gut-pouches of the actinian were now shut off from the archenteron we would have mesoblastic somites developed and structures formed which are exactly recapitulated in the development of the Arthropoda. That is, the outer layer in the budding appendages of the embryos of the latter, which grow out from each segment, are constituted of the same two layers, the outer of which gives rise to the hard, chitinous joints, and the inner to the muscles which move them.

In the development of bilaterality through the actinozoa the circle of tentacles would be drawn out into an ellipse, or so as to enclose an oblong space surrounding the archistome. This would bring the primitive appendages, after a free existence had been assumed by the supposed ancestral actinozoan type, into about the position in which they grow out in arthropod embryos around the archistome or furrow in the neural plate. The

post-anal telson or bristles, and the preoral labrum and one or two pairs of antennæ may be supposed to have been derived from a postanal, and a preoral series of tentacles respectively, supposing of course that the mouth is formed from the anterior part of the archistome, while the anus is formed from its posterior portion, while, as supposed by Sedgwick, the middle portion has coalesced.

The biramose legs of Crustacea and certain insects may be supposed to have arisen from a bilateral actinozoan type in which there were two rows of tentacles encircling the oblong archistome. When the inner and outer archipodia of one side, as we may name these primitive limbs, had fused at their bases, we would have a biramose appendage. As the outer layer became chitinized these appendages would become segmented. A very primitive type of limb, which may be supposed to have been derived from the tentacle of an actinozoan ancestry, is found in Peripatus. The parapodia of worms may also be supposed to have been derived from two such circles of archipodia which surrounded the archistome, but which, as the body became elongated, assumed a more and more lateral position. A new set of structures are, however, developed in the parapodia of errant marine worms, the analogues of which are found only in the fin-folds of the embryos of osseous fishes, or as the rays of the most primitive and undegenerate types of adult forms, namely, the Elasmobranchii, Holocephali and Dipnoi. These structures are the setæ which are of epidermal origin in the worms, or at most subepiblastic; as in embryo fishes and in Sagitta. In a former number of this journal I have called these structures in fishes actinotrichia; these are the same as the embryonic fin-rays mentioned by A. Agassiz.

The principal reason why I consider the actinotrichia found in fish embryos analogous if not homologous with the setæ found in the appendages of worms, is the fact that in both cases muscular processes of the mesoblastic somites first become attached to the inner ends of these fine horny or chitinous filaments, which in the worms protrude beyond the margins of the soft tissue of the parapodia, but which in embryo fishes and in Sagitta do not extend beyond the edges of the fin-folds. It is thus rendered obvious that bundles of muscular fibers derived from the muscular somites, developed from lateral gut-pouches, pass outward and are inserted upon the proximal ends of the setæ found in the parapodia of worms as well as the actinotrichia found in the fin-folds of fish embryos. In fishes these muscular processes are given off to the actinotrichia of the unpaired as well as to those of the paired fins. These muscular processes moreover pass outward into epiblastic folds in both cases metamerically or from each segment. In the worm to a bunch of setæ in a single parapodium, in the fish to a bunch or longitudinal series of actino-

trichia to the number of a dozen or so opposite each segment. In fish embryos the actinotrichia finally have their proximal ends drawn together out of their original parallel position under the epiblast of the fin-fold, and radiate more or less markedly from the point where the muscular process from the mesoblastic somite is inserted upon them, the same as the diverging setæ in the parapodia of worms. This divergency gives rise to the dichotomous character of the bony rays of Teleost fishes, since, as I have shown in a previous article, the actinotrichia are the rudiments of the permanent osseous, segmented rays of the malacopterygian type. For these reasons I am very strongly inclined to believe that the parapodia of worms and the fin-folds of fishes are very intimately and probably genetically allied to each other.

Another strong reason for such a belief is that in Sagitta in which the transverse septa in the body-cavity have been obliterated, as in Chordata, the setæ are found, as in fish embryos, lying parallel with each other and in horizontal, lateral, continuous fin-folds. This would seem to indicate that Sagitta had descended from a worm in which a lateral row of parapodia had gradually become fused together serially by their edges so as to form a more or less nearly continuous lateral fold. And I see no reason to doubt that a similar longitudinal or serial concrescence of primitively distinct metameric finlets may have occurred in the Protochordata, and given rise to the median and lateral longitudinal fold from which all of the fins develop. The next strong reason for this conclusion is that an actual longitudinal concrescence of the metameric elements of the paired and unpaired fins of fishes actually occurs. This is especially obvious to any one who has studied the mode of development of the fins of fishes in which extensive longitudinal concrescence has taken place, and of which any one who will examine an adult skate may easily satisfy himself. In this form the pelvic and pectoral pairs of fins have been formed of a primitively continuous series of metameric elements, as shown by the development. The anterior part of the lateral series of metameric elements of the fin-fold in this type are crowded together at their bases to form a pectoral, the posterior part of the series of elements are in the same manner crowded together to form the pelvic fin. In this way it comes about that the rays and metameric elements lose their original parallel position with respect to each other and become divergent distally, while the basal parts of the skeletal series of elements concresce or fuse to form the compound pro-meso and metapterygial pieces.

The lateral fins of fishes I regard as having arisen from the serially fused notopodial appendages of a worm-like ancestor, the unpaired fins in like manner I regard as having arisen from parapodia; the dorsal median fold from the two lateral rows of neuropodia which have concresced on the median line, and the ventral fold from the two rows of notopodia which have in like

manner fused together on the median line serially and transversely. The actinotrichia of all the fins are accordingly represented ancestrally in the slender embedded part of the parapodial setæ of worms.

These conclusions seem to support those of Dohrn, but also receive additional support from a consideration of the segmental organ and the way these are developed in certain worms, according to Hatschek, and in Chordata, according to Semper and Balfour. In one other important point the primitive Chordata and chætopods agree, namely, in the possession of a great number of segments or mesoblastic somites. I therefore regard the Chordata and Chætopoda as representing two divergent series. The former, upon the concentration of the muscular substance of the somites on the neural aspect of the body-cavity, and the abortion of the latter in the caudal region, acquired a new mode of progression, the tail then became vertically flattened, so that the parapodia were thrown into two rows dorsally and ventrally, and finally fused as supposed above; the displacment towards the middle line of the rows of parapodia being greatly favored by the lateral movements of the tail of the ancestral form. The presence of the body-cavity and viscera anteriorly probably prevented the shifting and median concrescence of the notopodia, so that they remain near their original position as the rudiments of the paired fins.

These views may at first seem far-fetched and improbable, but when I am able to present them more fully with new data and illustrations in a special memoir[1] upon which I am now engaged, I hope to be able to show that they lead to conclusions of the greatest possible moment in scientific morphology.—*John A. Ryder.*

PHYSIOLOGY.[2]

Medical Physics.[3]—The time has come when even in America it is recognized that medical education demands for a foundation a knowledge of those general chemical and physical laws which control the history of matter in all its forms. In Germany and France special courses in physics have long formed a part of the medical curriculum, and Dr. Draper has undertaken the difficult but praiseworthy task of preparing for the English-speaking medical student a non-mathematical text-book of physics which shall present with tolerable completeness an account of matter and its laws, with special reference to their bearing on the physiological processes of the body. There are probably few scientific subjects in which the selection of material and the method of

[1] Studies on the development of the Chordata and Achordata, together with an exposition of the Archistome-theory.

[2] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

[3] By J. C. Draper, M.D., LL.D. Lea Bros. & Co., 1885.

presentation involve so much difficulty as that now considered. Dr. Draper wisely takes particular pains to expound clearly the received ideas concerning the structure and properties of matter; and especially useful, for the most part, are the frequent statements and applications of the facts of molecular mechanics.

The general division of the subject into Matter and Energy is admirable for purposes of teaching, and perspicuity of treatment has been attained with marked success.

It is unfortunate, however, that the author should have repeated from the older text-books so much that is erroneous, in his consideration of the physiology of the subject. There are few physiologists of to-day who would not read with astonishment the elaborate defense of the chemical attraction theory of the circulation advanced on p. 308. Again (p. 158), the modern lecturer has annually to deny the statement, "when breathed in the unmixed state it (oxygen) stimulates the nervous system strongly and finally causes death."

No physiological worker now considers fibrin, as such, a constituent of blood-plasma (p. 193).

We must insist that the whole idea involved in the discussion of the relation of animal tissues to oxygen (p. 206) is wrong. We were under the impression that since the labors of Helmholtz there was little cause to dispute the conclusion that the function of the auditory ossicles was to convey vibrations to the internal ear, though Dr. Draper apparently considers the question as to their function still open (p. 375).

It is to be hoped that in a subsequent edition of the work, and such will no doubt be quickly called for, these manifest blots will be eliminated.

Influence of Cocaine, Atropine and Caffeine on the Heart and Blood-vessels.—Dr. Beyer's work was performed upon the terrapin after the most exact physiological methods.

Cocaine added to calf's blood supplied to the physiologically isolated heart first causes a slight quickening in the rhythm of the beat and an increase in the amount of work done as measured by the quantity of blood pumped out. A succeeding and more pronounced effect of the drug is a selective inhibition of the ventricular beat whose rhythm is reduced one-half, that of the auricles remaining normal. It is interesting to note that this slowing of the ventricular rhythm is not accompanied by a decrease but, on the contrary, often by an increase of work done. In large doses cocaine causes an arrest of the heart in the phase of diastole, but recovery may usually be brought about by the supply of fresh blood. Cocainized blood sent directly into the arteries and, after circulating through the vascular system collected from the venæ cavæ, produces in all doses a constriction of the smaller blood-vessels as indicated by the diminution in the amount of outflow-

ing blood. Beyer concludes that the elevation of arterial blood-pressure which follows the administration of cocaine depends upon its united stimulating effect upon the heart and the blood-vessels; a fall of blood-pressure coming on after the rise must be due to the action of cocaine on the heart alone, because its constricting effect upon the blood-vessels outlasts its stimulating action on the heart.

Like previous observers, the author found that atropine in certain doses increases the rate of heart-beat and also the amount of work done, and moreover it exercises an inhibitory influence over the contractions of the ventricle. It is argued that the action of the two drugs upon the heart is almost identical, the main difference being that the initial stage of stimulation by cocaine is much shorter and may be produced by smaller doses than is the case with atropine. The author concludes from the evidence of many data which cannot be recorded here, that the specific action of both cocaine and atropine is upon the muscular substance of the heart.

Caffeine in rather small doses increases the rate and power of heart-beat and the amount of work done. Supplied directly to the blood-vessels caffeine produces in all cases a dilatation; its total action in the uninjured animal ought, therefore, to cause the maximal amount of blood to circulate through the system in a unit of time.—*Am. Jl. Med. Sci., July, 1885.*

Restriction of Vaso-motor Excitement in Hypnotized Patients by Suggestion.— Hallucinations are readily excited in hypnotized persons when various ideas are suggested to them, but M. Dumontpallier finds that the influence of such suggestion is able also to extend itself definitely over the purely organic processes of the body.

Two hysterical patients were hypnotized and a piece of paper was held in place by a linen bandage upon the upper inner surface of each of the four limbs of either patient. It was now declared to one patient that the region under the paper upon the left leg was being blistered; while the other patient was assured that the corresponding area of the right leg was suffering the same treatment. Each patient complained, both while in the normal and in the hypnotized condition, of a burning sensation in the places to which the attention had been directed. The hypnotic condition was re-induced two or three times during forty-eight hours, and the temperature of the skin was tested by a thermometer whose bulb was passed under the bandages. In the first patient, at the end of forty-eight hours, the skin under the paper on the left leg showed a temperature elevation of 2.8° C.; in the second patient the temperature of the skin under the paper on the right leg was raised 3° above the normal at the end of one, and 2.4° at the end of two days. In the case of each

patient the area of suggestion had a higher temperature than the corresponding area of the other leg. It is concluded that by mere suggestion to a hypnotized person there may be produced in him vaso-motor dilatation over any area of the skin chosen at will.—*Comptes Rendus, T. ci, p. 228.*

Koch's Cholera Bacillus.—M. Pouchet reports the interesting fact that he has extracted from the broth used as culture-medium for Koch's cholera-bacillus an alkaloid which appears to have all the external characters (odor, chemical instability, toxic effect upon animals) of a substance which can be isolated from choleraic dejections.—*Comptes Rendus, T. ci, p. 510.*

Heat Center in the Brain.—A few years since Dr. H. C. Wood, of Philadelphia, published an extended account of researches, in which experimental support was given to the hypothesis that certain areas in the cerebral cortex act as nerve centers for the regulation of the production of animal heat. Two German students have quite recently partly confirmed these observations after a much less troublesome method than that employed by Wood. The operation is performed upon guinea-pig, rabbit or dog, and consists in passing a needle through the skull at the place of union of the sagittal and coronal sutures, some millimeters to the right or left of the longitudinal sinus. The needle is pushed in a perpendicular direction as far as the base of the skull and is then withdrawn. Succeeding this treatment there is an immediate rise of temperature throughout the body to the extent of several degrees. At the same time the frequency of respiration is slightly increased and there is diminution in the amount of chlorides in the urine, but the animal remains well and in two or three days the phenomena disappear. The operation may then be repeated with like results upon the same animal. It is not decided whether the effects described are due to the temporary stimulation of a heat-production center or to the paralysis of a heat-inhibitory center in the part of the brain which is punctured.—*Arch. f. Anat. a. Phys., 1885, p. 166.*

Specific Energy of Skin Nerves.—In a previous communication (Naturalist, 1885, p. 417) Magnus Blix is reported to have experimentally verified the hypothesis that the sensations of heat and cold each have their appropriate nervous organs in the skin, and that author's latest researches go to show that the sense of pressure is also aroused through a third special set of sensory nerves distributed to the skin.

The sensibility of skin to pressure was tested by letting fall, by means of an elaborate apparatus, a small weight upon the surface to be investigated. In this way it was found that an area not covered by tactual hairs could be mapped out in points of various sensitiveness arranged symmetrically around certain centers of

greatest sensibility. Probably all hairs are tactile organs. On the dorsal side of the left hand the minimal stimulus for a circular group of pressure points was represented by the figure 0.23, while on certain intermediate points the force necessary to be applied in order to evoke sensation was represented by 1.5. The pressure points on the back of the hand were more sensitive than those upon the middle of the fore-arm and still more so than those upon the thigh. The skin appears most sensitive to pressure where the tactile corpuscles of Krause are most numerous. In true scar tissue neither cold, warm nor pressure points can be discovered. Many points of the skin are insensitive to pain, as tested by needle-puncture, while others are extremely susceptible. It is very probable that sensations of pain depend upon direct injury of a sensory nerve trunk.—*Zeitschr. f. Biologie, Bd. xxi, p. 145.*

PSYCHOLOGY.

Mind and Motion.—The Rede lecture delivered last week in the Senate House, at Cambridge, by Mr. G. J. Romanes, M.A., F.R.S., was entitled "Mind and Motion." After giving some account of the teaching of Hobbes, who laid it down, on the one hand, that all our knowledge of the external world is but a knowledge of motion, and, on the other, that all our acquisitions of knowledge and other acts of mind imply some kind of "motion, agitation, or alteration, which worketh in the brain," Mr. Romanes pointed out, as regards the internal world, that physiology has proved that molecular movements of nervous matter are concerned in all the processes of reflex action, sensation, perception, instinct, emotion, thought, and volition. The lecturer detailed the discoveries which of late years have been made by physiology concerning the rate at which these movements travel along nerves, the period of molecular vibrations in nerve centers, the time required for processes of thought, and the quantitative relations between brain-action and mind-action. When physiological instruments fail to take cognizance of these relations, we gain much additional insight touching the movements of nervous matter by attending to the thoughts and feelings of our own minds, for these are so many indices of what is going on in our brains. Proceeding to contemplate the mind, considered thus as a physiological instrument of the greatest delicacy, he argued that the association of ideas is but an obverse expression of the fact that when once a wave of molecular disturbance passes through any line of nerve structure, it leaves behind it a change in the structure, such that it is afterwards more easy for a similar wave when started from the same point to pursue the same course. Such being the intimate relation between brain-action and mind-action, it has become the scientifically orthodox teaching that the two stand to one another in the relation of cause to

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effect. He pointed out that the doctrine of conscious automatism is logically the only possible outcome of the theory that nervous changes are the causes of bodily changes, and, therefore, it cannot be fought on grounds of physiology. If we persist in regarding the relation between brain and thought exclusively from a physiological point of view, we must of necessity be materialists. But it does not follow from this that the theory of materialism is true; and other considerations of an extra-physiological kind conclusively prove that the theory is false. We have, first, the general fact that all our knowledge of motion, and so of matter, is merely a knowledge of the modifications of mind. Therefore, so far as we are concerned, mind is necessarily prior to everything else. Thus the theory of materialism assumes that one thing is produced by another thing, in spite of an obvious demonstration that the alleged effect is necessarily prior to its cause. But further, "motion produceth nothing but motion," says Hobbes, and yet he immediately proceeds to assume that in the case of the brain it produces not only motion, but mind. Materialism has to meet the unanswerable question—How is it that in the machinery of the brain motion produces this something which is not motion? Science has now definitely proved the correlation of all the forces, and this means that if any kind of motion could produce anything else that is not motion, it would be producing what science would be bound to regard as in the strictest sense of the word a miracle; causation from brain to mind is in the strictest sense of the word a physical impossibility. *Mutatis mutandis* the theory of spiritualism—which supposes causation to proceed from mind to body—is, he held, but little less unphilosophical than the opposite theory of materialism. For just as it follows from the conservation of energy that motion can produce nothing but motion, so it equally follows that motion can be produced by nothing but motion. Is there, then, any third hypothesis in which we may hope to find intellectual rest? If we unite the elements both of spiritualism and of materialism, we obtain a product which satisfies every fact of feeling on the one hand, and of observation on the other. We have only to suppose that the antithesis between mind and motion, subject and object, is itself phenomenal or apparent, not absolute or real; that the seeming quality is relative to our modes of apprehension; and, therefore, that any change taking place in the mind and any corresponding change taking place in the brain are not really two changes, but one change. There is thus supposed to be only one stream of causation in which both motion and mind are simultaneously concerned; motion is supposed to be producing nothing but motion, mind-changes nothing but mind-changes. Both producing both simultaneously, neither could be what it is without the other, because without the other neither could be the cause which in fact it is. The use of mind to animals is thus ex-

plained, for intelligent volition is shown to be a true cause of bodily movement, seeing that the cerebration which it involves would not otherwise be possible. This monistic theory thus serves to terminate the otherwise interminable controversy on the freedom of the will; for the theory shows it to be merely a matter of terminology whether we speak of the mind or of the brain as the cause of bodily movement. That particular kind of physical activity which takes place in the brain could not take place without the occurrence of volition, and *vice versa*. All the requirements alike of the determinist and of the free-will hypotheses are thus satisfied by a synthesis which comprises them both in one. Mr. Romanes afterwards reviewed the opinions of the late Professor Clifford upon this subject, and concluded by observing that if it were true that the voice of science must of necessity speak the language of agnosticism, at least let them see to it that the language was pure; let them not tolerate any barbarisms introduced from the side of aggressive dogma. So would they find that this new grammar of thought did not admit of any constructions radically opposed to more venerable ways of thinking, and that the often-quoted words of its earliest formulator applied with special force to its latest dialects—that if a little knowledge of physiology and a little knowledge of psychology incline men to atheism, a deeper knowledge of both, and still more a deeper thought upon their relations to one another, could only lead men back to some form of religion, which, if it be more vague, will also be more worthy than that of earlier days.

ANTHROPOLOGY.[1]

FURTHER CONFIRMATION OF THE POST-MORTEM CHARACTER OF THE CRANIAL PERFORATIONS FROM MICHIGAN MOUNDS.—In a paper entitled "Burial Customs of our Aborigines," read by the writer before the Ann Arbor meeting of the American Association, August 28, 1885, two fragmentary crania, recently exhumed from a mound on the Detroit river, Michigan, and presenting good examples of the peculiar custom of cranial perforation, were exhibited as illustrations in the anthropological section. The cephalic index of the first specimen would throw it into the medium or orthocephalic group, or to follow the nomenclature of Professor Broca, the mesaticephalic division. The single circular perforation occupies, as usual, a central position at the vertex of the skull, being situated on the sagittal suture, about 0.6 of an inch back of its junction with the coronal suture. The perforation is 0.4 of an inch in diameter, and was probably made in the same manner as were all those I have seen, by a rude stone implement rotated by hand.

The second specimen is evidently not of as great antiquity as

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

the first. Its fragmentary condition, the entire occipital bone and parts of the parietal bones being wanting, prevents most of the usual measurements being taken; but though a smaller and narrower skull than the first mentioned, its cephalic index would, doubtless, place it in the same range, viz., that of the mesaticephali. It is, however, most interesting in presenting the unusual feature of having two perforations. The smaller of these, less than 0.4 of an inch in diameter, is situated on the sagittal suture, and about 0.1 of an inch back of its junction with the coronal suture. The second perforation is over 0.4 of an inch in diameter, and is placed on the frontal bone, in a straight line with the direction of the sagittal suture and 0.35 of an inch from its junction with the coronal suture. The perforations from center to center are 0.8 of an inch apart.

In my examination of these specimens I have made the important discovery that the perforations in both of them are countersunk, or made from both sides—from the inside as well as the outside of the skull. The beveled edges unquestionably settle this point, and are a further confirmation, if any such were required, as to the perforations being *post mortem*. This is a point overlooked by me in my previous studies, and, indeed, doubtless is wanting in the perfect crania, where the perforations could not well have been made except from the outside of the bone.

These two specimens present many of the characteristics observed by me in other crania I have taken from our mounds. In the second and narrower skull the outlines of the orbital cavities, wanting in the first and larger cranium, are decidedly quadrilateral; the frontal protuberances are less pronounced, and the glabella, which in the first specimen is replaced by a slight depression between the superciliary arches, is represented by the usual swelling. The first skull, which, as I have already stated, is the more ancient of the two, is further distinguished by having a small though decidedly developed epactal bone. This bone, sometimes called the "bone of the Incas," from its prevalence in ancient Peruvian skulls, I have already called attention to as occasionally pertaining to the more ancient crania from our Michigan mounds; and also to a certain inclination (if I may so describe it) to produce this bone, as though at one time some ancestors had possessed this distinctive characteristic, but that the peculiarity was gradually eliminating in the later generations, possibly through intermixture with other races.

Both of the specimens seem to have belonged to male adults, as do all others of the perforated skulls which I have observed.—*Henry Gillman, Detroit, Michigan.*

PILLING'S BIBLIOGRAPHY.—The most valuable work as yet issued by the Bureau of Ethnology is a volume bearing the following title: Proof sheets of a Bibliography of the Languages of North American Indians. By James Constantine Pilling. (Dis-

tributed only to collaborators.) Washington: Government Printing Office, 1885. [pp. 1135, gr. 8vo.] This work was commenced by Mr. Pilling several years ago, and with unflagging and systematic assiduity prosecuted amid the distractions of a laborious and exacting Government appointment. In the first place the sources of information have been exhaustively consulted from Adelung to Williams. The feeling of security and confidence is at once awakened on one's finding that the catalogues of Adelung and Vater, Alcedo, Andrade, Asher, Bartlett, Berendt, Boturini, Brinley, Brinton, Clarke, Field, Icazbalceta, Ludewig, Ramirez, Sabin, Steiger, Trumbull have all been exhausted and their personal aid in many instances has been secured. The rules of cataloguing adopted by the consensus of leading libraries have been carried out, so that in this case we have an alphabetical list of persons or societies that have written in or upon the Indian languages of North America, with full and accurate titles of all editions of their writings. This is not all. Every page of the work furnishes brief abstracts of works, the author's own statement of his purpose in his work, the annotations of distinguished critics who were conversant with the several languages. Mr. Pilling has also kept a record of his own difficulties in finding many of the publications recorded, so as to make the task of hunting, which was extremely laborious to him, easy to those who come after him. Finally, no one is omitted. If he is, it is because he has been hiding, and it will be necessary only to know of his existence to drag him into publicity in the final issue. The error is really on the other side, and many titles are included for trivial reasons. Major Powell receives from the author and richly deserves the highest commendation for the encouragement which he has given. There is, perhaps, a little too much mutual admiration between patron and author for a work of such magnitude. This is carried to a ridiculous extent when over thirty pages are given to members of the Bureau of Ethnology, one page to the Smithsonian Institution and three inches to W. W. Turner. It is to be hoped that all who are interested in American philology will call Mr. Pilling's attention to works on American Indian languages which are in the least danger of escaping his observation.

The Mound-builders and the historic Indians.—A very remarkable treatise upon this subject appeared last year in *Kosmos*, and now comes to us in a separate pamphlet, from the pen of Dr. E. Schmidt of Leipzig. The author starts out with the assumption that most American archæologists see in the builders of the mounds a definite ethnological unit, differing from the historic Indians in their anatomy but more in their culture. These mound-builders peopled in compact settlements the Mississippi valley, ruled by despotic government, worshiping the sun with human sacrifices in temples and altar-places, and living upon the

productions of agriculture. They were advanced in the art of spinning, weaving, metallurgy and keramic. They fortified themselves with circumvallation and buried their dead in mounds. A cataclysm cut off these people from the historic Indians who are absolutely new-comers upon the soil, as were the whites who succeeded them. Now Dr. Schmidt holds that the same revolution of sentiment which has substituted in geology a gentle and gradual evolution for the preceding notion of sudden breaks in creation will also take away the theory of mound-cataclysms and prove the continuity of social history on our continent.

One of the favorable symptoms of this change of opinion is the substitution of mound-anatomy, ochthotomy, for the older process of mound-rummaging. The NATURALIST defines anthropology to be the application of natural history methods and apparatus to human phenomena. Mound-anatomy is the application of the methods of the biological laboratory to the examination of a mound. Dr. Schmidt, after giving a good résumé of the distribution and classes of mounds, in which he always eliminates the marvelous, the extraordinary and the mythical, follows very closely Professor Putnam in his latest researches. "In truth," says he, "the mounds tell us nothing of the political organization of their builders, the sacrificial mounds are nothing more than burial tumuli for cremation. We make an absolute step in knowledge when we say that we know nothing of the sociology and religion of the mound-builders." Furthermore, in studying the geographical distribution of mounds, it is seen that special types characterize given areas. It is not to be supposed that one people acted so differently without the motive of great climatic variation. These types of remains speak of different peoples who developed their several ideas. The thousand and one perishable things that have fallen victims to time and fire more definitely expressed this separation, and the things that remain are like the few words in common throughout the Aryan tongues, telling of a common origin further back. The crania of the mound-builders are, for the most part, artificially deformed, as are those of many modern tribes of America. The time of these peoples extends from many centuries before Columbus far into the historic period of the continent.

On the other hand, when we seek to compare the mound-builders with the modern Indians, we find our ignorance almost as profound respecting the latter. Nothing is more unjust than to place in opposition an exaggerated view of the former with the most degraded types of Indians. In New England, New York, Pennsylvania, Virginia, all through the South, the early settlers were actually kept from starving by the aboriginal maize fields. In all of these self-same localities were fortifications, circumvallations, fossettes, platforms, as among the mound-builders. Did the mound-builders trace animal forms in earth? the Indians

of New Mexico paint their altars in colored sands to-day. The terraced mounds, cremation, ossuaries, stone mounds, deposit burial, art productions for peace or war, traditions of the great Eastern stocks are all ably examined by Dr. Schmidt, and wonderful parallelisms pointed out.

Finally, relying greatly upon Mr. Hale's "Indian migrations as evidenced by language," the author revives the story of the Allegewi. There's the rub. The number of American archæologists who believe that the mound-builders were not Indians at all is very small. We have never seen one. There are all grades of believers in the amount and quality of relationship between the mound-builders and historic Indians; but which mound-builders and which historic Indians, that is quite a different thing.

The Natives of New Guinea.—It is usually stated that two types of man exist in New Guinea; the one Melanesian, or so-called Papuan (which prevails from Flores to New Caledonia and Fiji), occupying the bulk of the country; the other, a fairer, milder race, having decided affinities with the Polynesian, found on the south coast of the eastern peninsula. Members of the former division, however, differ widely in appearance in different parts of the island. Not only have they in some instances undergone great admixture, as, *e. g.*, on parts of the north coast, where the type has been refined by mingling with a superior and possibly immigrant strain, but elsewhere, in the interior and on the coast, as at Sorong in the north-west and on the east side of Geelvink bay very degraded types are found. The fairer race show signs of great admixture and deviation from the Polynesian type. The Papuans preserve the heads of enemies and the skulls and jawbones of relatives. The "great house," many hundred feet long, and containing several families, is found in New Guinea, as in Borneo and among the Mishmis and Nagas of Assam; the last-named having also, like the Papuans, separate houses for bachelors, and, unlike them, others for maidens. The Malay practice of building on piles is also common throughout New Guinea, even high up on the mountain sides. In the south-east stockaded villages are built on the steep spurs of hills, surmounted by a *dobbo*, serving as a watch-tower and as a refuge from human and spiritual enemies. Houses are also built on the ground with low walls and projecting eaves. In some places are larger houses, ornamented outside with figures of birds, etc., which seem to correspond to the council-house. The Papuan is a savage of a high order. Although still in the stone age the artistic faculty is shown in the carvings on canoes, houses, implements and weapons. They are fond of flowers. They trade massoi bark, nutmegs, bird skins, pearl- and tortoise-shell, trepang and slaves for cotton cloth, iron and copper ware, knives, beads, mirrors, indigo and arrack.—*C. Trotter in Proc. Roy. Geog. Soc., vi, 196.*

The Marl Beds of Kunda.—Professor C. Grewinck, in the University of Dorpat, has written a pamphlet of seventy-two pages on the marl beds of Kunda, in Estland, Province of Livonia, on the Gulf of Finland, Russia. The marl beds are three versts from the sea, between the town and the River Kunda. The first portion of the pamphlet describes the geologic features of the locality. From page twenty to the end an account is given of the bones of vertebrates and the bone implements found in the marl. The animals include *Equus caballus*, *Bos taurus*, *Cervus alces*, *Cervus capreolus*, *Cervus tarandus*, *Sus scrofa*, *Canis familiaris*. The horse and ox are most common, and are found as well in the marl as in the bog, generally gnawed. The bone implements are mostly harpoon points and piercers, and the position of the pieces is accurately described.

Anthropology in Japan.—[Trans. As. Soc. of Japan, xi, pts. 1 and 2, xii, pt. 1].—*Food-plants in Japan.*—Mr. Edward Kinch, in the Transactions of the Royal Society of Japan, vol. xi., pp. 1–38, presents a tabulated list of the food-plants of Japan. The systematic name, the Japanese name, and, in many cases, the English name is given. The author also states the part of the plant that is useful, the use to which it is put, and any interesting facts known. Dr. Geerts makes some observations on this list and draws attention to Siebold's "Synopsis plantarum œconomicarum universi regni Japonici," Trans. Batav. Soc. of Arts and Sc., xii, and to Dr. S. Syrski's article on Japanese economic plants, pp. 175–220, in von Scherzer's Fachmanuische Berichte, etc., Stuttgart, 1872.

Ainos of Tsuishikari.—Tsuishikari is a hamlet in Sapporo, twelve miles east of the city. The Ainos who people it are a colony from Sagalin that, in 1875, at the invitation of the Japanese government, left their native island. From 1863–1875 Japan was engaged in settling with Russia her frontier in Sagalin, and ended by exchanging for the Kuriles. In 1875 she granted lands on the Ishikaro to her Sagalin subjects. Seven or eight hundred came and built their straw huts. These Ainos are fishers and live on fish, rice and pounded lily roots. Hunting the bear is their glory, and they will attack the animal with a bow and a knife. The men are fine looking, and no hairier than many Englishmen. The women and girls tattoo the cheek with the juice of the haba tree. The dress of both sexes is gaudy and not unlike. The weapons are the bow, sword, and dagger. The women smoke more than the men, and are also the musicians, playing the Jew's harp, the harp, and a two-bridged harp (*tonkare*). Their houses are no better than our Indian huts, and interiorly are furnished like them. All their home-made vessels are of wood. Bear cages are a constant adjunct for raising cubs, whose Aino mistresses suckle them when they are very young. These

home-bred bears are killed at the bear festival in September. The system of consanguinity and affinity is not well worked out. When an Aino dies, bowls of water and rice are placed by the corpse for two or three days. The body is placed in a wooden box with a pan, a cup, a sword, and a gilt rod. The burial is very retired, and the hut is not burned; on the contrary, it is allowed to remain as the residence of succeeding generations. They worship deities innumerable, every natural object furnishing one. The medicine man does not differ from the same functionary in all other tribes of their *gradus.—Mr. J. M. Dixon, in Tr. As. Soc., Japan, XI, 39–50.*

Japanese Tea.—Part I, vol. XII, pages 1–32, plates I–XXI, is devoted to a monograph on the preparation of Japan tea. By Henry Gribble.

ANTHROPOLOGICAL NEWS. — Professor F. W. Putnam draws attention to the following extract from the *American Journal of Science*, XLIV, 1843, p. 302, written by Dr. John T. Plummer of Richmond, Wayne county, Ind.: "A tusk [of the mastodon or mammoth] was exhumed from the gravel, fifteen feet below the surface, while excavating the Whitewater canal near Brookville, thirty miles south of Richmond; a club-shaped implement, formed apparently of cliff limestone, was also taken out of the gravel ten feet below the surface, near the spot where the tusk was found."——A writer in *Science* draws attention to the following sources of information respecting the aboriginal languages of S. America:

Professor Friedr. Müller in Grundzüge der Sprachwissenschaft.

Lucien Adam in Examen grammatical de seize langues américaines, Genoa, 1882.

Dr. Julius Platzmann in Glossar der Feuerländischen sprache.

Giacomo Bove in I Fuegini, secondo l'ultimo suo viaggio, Parte prima, Genova, 1883.

John Luccok, Grammatical elements and a vocabulary of the Tupi language or lingoa geral, of Brazil, Rio Janeiro. H. Laemmert & Co., 1882.

Dr. Julius Platzmann, fac-simile edition of Havestadt's book of Chilidúqu [see *Science*, III, 550].

R. B. White, A short ethnographic and linguistic study of the Indians of Antioquia and of the Cauca valley, U. S. Colombia.

J. Anthrop. Inst., &c.. 1884. [Contains vocabularies of the Noánama and Tadó dialects of the Choco family].

Edwin R. Heath, Vocabularies of Canichana, Cayuába, Mobíma, Moseteria, Pacavára, Marópa and Tacana languages of Bolivia.

Braz da Costa, Vocabulos indigenas e outros introducidos nouzo vulgar. [Foreign and Indian words introduced into the Portuguese of Brazil.]

A. H. Keane, On the Botocudos, also called Aimorés, J. Anthrop. Inst., Nov., 1883. *Botocudos* means "those wearing the lip ornament."

J. J. von Tschudi, Organismus der Kechna sprache, Leipzig. F. A. Brockhaus, 1884, pp. 534.

Giovanni Pelleschi, Sulla lingua degli Indiani Mattacchi del Gran Chacco, Frienze, 1881.

F. di la Carrera, Arte de la lingua Yunga, Lima, 1880.

——S. Carlos von Koseritz has published "Bosquejos Ethnologicos," a series of papers contributed by him in the last three years to the Gazeta de Port Alegre on anthropological subjects in the province of Rio Grande do Sul and other parts of Brazil. Stone implements of a strictly Palæolithic type appear to be very rare in von Koseritz's collection, and as they occur promiscuously with Neolithic objects, the author infers that it is impossible to determine a Palæolithic antecedent to a Neolithic age in Brazil. Many pieces were found associated with the remains of the Megatherium, "*Rhinoceros tichorinus*"(*! !*) and the cave bear. But a skeleton recently found in a shell mound on the banks of a fresh-water lagoon near Cidreira, three miles from Rio Grande, convinces the writer that the early inhabitants of South Brazil were of a lower type than the Charruas and others in possession of that region in the historic period. The Botocudos of the Aimores mountains have more nearly the features of the Cidreira cranium (*Nature*, Aug. 21, 1884).——Those who are interested in the subject of the *jus prima noctis* will find it thoroughly discussed by Dr. Karl Schmidt in Zeitschrift für Ethnologie, XVII (1884), pp. 18–59. The author seems to be familiar with the literature of the subject, and gives innumerable references to authorities, ancient and modern.

MICROSCOPY.[1]

A MEANS OF DIFFERENTIATING EMBRYONIC TISSUES.—It may be safely assumed that all hardening and staining fluids possess, in a higher or lower degree, the power of *developing*, in the photographer's sense, histological distinctions between embryonic cells, long before these distinctions become manifest in perceptible morphological differences. It is evident, also, that this differentiating action varies in strength according to the conditions under which the reagents are applied. Our knowledge of the ways and means of controlling this action is still very meager; but it is sufficient to show that the histological technique of the future has much to hope for through experimentation in this direction. One of the best ways of intensifying the differential effects of hardening fluids, is to use several of them in combination or in sequence. The use of osmic acid, followed by Merkel's fluid, is an example of this kind. The advantages of this method in the study of pelagic fish eggs have already been noticed,[2] and I wish now to state briefly what the method will accomplish when applied to the eggs of Clepsine. The mode of procedure is as follows:

The eggs are placed in ¼ per cent solution of osmic acid for ten minutes, then rinsed in clean water and transferred to

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] AMERICAN NATURALIST, Nov., 1883, p. 1204, and Proc. Am. Acad. Arts and Sci., XX, p. 28, 1884.

Merkel's fluid (platinum chloride, 1/4 per cent, and chromic acid, 1/4 per cent, in equal parts), in which they are allowed to remain one and a half hours. They are next washed in flowing water for the same length of time, then treated with 50 per cent and 70 per cent alcohol. They need remain only a short time in the first grade of alcohol (about thirty minutes), but should be left for twelve to twenty-four hours in the second. For staining, I have used Grenacher's alcoholic borax-carmine, adding to it from one-third to one-half its volume of glycerine. The glycerine intensifies the action of the dye, so that a moderately deep stain is taken in the course of twenty-four hours.

It should be mentioned that it is best to stain immediately after the eggs have remained the required time in alcohol, as receptivity for the staining fluid diminishes considerably with the lapse of time. The osmic acid has time to penetrate to all parts of the embryo, and the blackening is arrested and partially removed by the action of Merkel's fluid. The differential effects of the osmic acid are, however, sharpened under the influence of the chrom-platinum solution.

This method has enabled me to trace out the history of the entoderm, and the precise origin of the nerve-chord, nephridia, salivary glands, larval glands, &c. The results of my study will be published in full later, and I shall here only give the more important conclusions. Each of the germ-bands, as I have shown elsewhere,[1] is made up of three distinct layers, namely: (1) an epidermal layer; (2) a layer consisting of four longitudinal rows of cells, and (3) a deeper layer, next to the yolk, composed of larger cells.

The four rows of cells, forming the layer subjacent to the epidermis, are the products of four larger cells at the posterior end of each germ-band. These four cells are called "*neuroblasts*" in the papers referred to. The innermost layer, which is wholly mesoblastic, is derived from a large "mesoblast," which lies below the four "neuroblasts." Thus the two deeper layers of each germ-band is made up of the products of five cells.

The main point to be determined was the precise origin of the nerve-chord. In my first paper dealing with this subject I was unable to settle this point satisfactorily. I satisfied myself that the nerve-chain was formed from the products of the so-called "neuroblasts," but I was mistaken in supposing that *all* of these products entered into its composition.

The method above given has shown that of the eight rows of these cells (four in each band), only the two median ones give rise to the nerve-chord. The lateral row of each band probably gives origin to muscular elements, while the two rows, lying between the median and the lateral rows, furnish the basis for the nephridial

[1]Quart. Jour. Mic. Sc., 1878, and Zool. Anz., No. 1.

organs. The two median rows of nerve-cells are faintly browned with osmic acid, while the four rows of nephridial cells are deeply browned, forming thus a sharp contrast in color. The two lateral rows are faintly stained. The development of the ganglionic chain progresses from the head backwards, so that in surface views it is easy to trace the two simple rows of nerve-cells forward into the fully outlined ganglia. The same has been done on sections, leaving no doubt as to the origin of the nerve system of the trunk. I am not able to say whether the two rows of nerve-cells extend into the cephalic lobe; but I am certain that the nerve-collar, including the supra-œsophageal ganglia, is formed from cells that lie beneath the epidermis, and not from a thickening of the epidermis itself.

The epidermis overlying the nerve-cells destined to form the four sub-œsophageal ganglia, thickens up at an early date and eventually becomes from two to three or more cells deep. This thickened portion of the epidermis has nothing whatever to do with the formation of any part of the nervous system. The deeper cells of this thickening form provisional gland-cells, which serve to attach the embryo, after its escape from the egg-membrane, to the ventral side of the parent. In this manner the young are carried about until the posterior sucker is developed sufficiently to serve as an organ of attachment. These gland-cells are colored dark brown, and are thus very easily distinguished from the lighter-colored nerve-cells lying beneath them.

The epithelium of the whole alimentary tract, excluding the stomodæum (pharynx) and proctodæum, which are derived from the epidermal layer, arises from free nuclei belonging to the three large blastomeres (*a*, *b* and *c* in my figures). The cells which form the œsophagus are the first in order of development, making their appearance just beneath the stomodæal thickening, in the very earliest stage of the germ-bands. From the mass of cells formed at this point arise not only the œsophageal epithelium, but also the salivary glands. The method employed gives preparations in which all the embryonic tissues of the head and anterior portion of the trunk (epidermis, larval gland, salivary glands, nerve-cells, muscle-cells, and œsophageal epithelium) are distinguishable.

The cells destined to form the epithelial lining of the stomach arise later than those of the œsophagus. They appear first as distinct cells, on the ventral side, at the anterior end of the future stomach, at about the time of hatching. Their development is progressive from this point backward and upward towards the dorsal side. In an embryo just hatched, I can trace these cells along nearly the anterior half of the median ventral line, and farther back I find free nuclei in the surface of the yolk. In the median dorsal line, I find no fully formed endoderm cells (except salivary gland-cells), but do find free nuclei in the anterior half.

The sense-organs of the lip arise as bulb-like thickenings of

the epidermis. At the time of hatching, long before the eyes and segmental sense-organs appear, two pairs of these sense-bulbs are found, symmetrically placed on the surface that is to form the margin of the lip. The symmetrical arrangement in pairs, the second pair being a little behind the first and farther apart, suggests that these organs were primarily strictly segmental.—*C. O. Whitman.*

Repairing Balsam Preparations.—When balsam preparations have been made with a very thin solution, or with a small amount of fluid, evaporation sometimes causes the balsam to be invaded by air spaces which it is difficult to refill, even with a thin solution of balsam. Such spaces may readily be filled with the solvent of the balsam (benzole), and then a drop of thin balsam placed at the edge of the cover glass will gradually replace the benzole as it evaporates, without leaving air spaces. To prevent a too rapid introduction of the benzole, it is desirable to transfer it with a glass tube drawn to capillary fineness at one end, rather than with a glass rod. If the tube is not too large—5 or 10^{mm}—and is drawn out quite gradually, enough benzole may be sucked into it to serve for repairing a large number of slides without danger of loss by its running out or by evaporation when the tube is laid down. The application of the capillary end of the tube to the edge of the cover glass induces a steady and even flow of the fluid, until the space beneath the cover glass is completely filled. —*E. L. Mark.*

The Eyes of Annelids.[1]—For the study of these small eyes it is necessary to make very fine sections and to remove the pigment. The decoloration of the eye may be effected by soaking in glycerine, to which a little 35 per cent caustic potash has been added. When the work of decoloring has been carried sufficiently far, it should be checked by neutralizing with dilute hydrochloric acid; and then the preparation should be carefully washed before transferring to a hardening or mounting fluid. The preparations are best preserved in glycerine.

A New Solvent of Chitin.—In a previous number of "Microscopy" I have called attention to the use of hypochlorite of potassium (KClO), or Eau de Javelle, as an agent for removing the soft parts of such animals as Spongilla, and for preparing skeletons of small animals. Dr. Looss[2] now recommends this fluid and the corresponding combination with sodium (NaClO) as excellent solvents of chitin. The thickest and hardest chitinous parts of insects, after soaking long enough to become transparent and perfectly colorless, may be quickly dissolved by boiling in one of these agents.

If the commercial fluid is diluted by adding 4-6 times its volume

[1] Graber, Archiv. f. mikr. Anat., XVII., p. 250, 1879.

[2] Zool. Anzeiger, VIII, No. 196, p. 333, June, 1885.

of water, and the chitinous parts to be studied immersed (either fresh or hardened) for twenty-four hours or more, the chitin is rendered permeable to staining fluids. Nematodes and their eggs may be successfully treated in the same manner. It is remarkable that the underlying soft parts do not suffer, the finest structural conditions being preserved. The potassium compound acts with more energy than the sodium compound.

WHITE ZINC CEMENT.—This cement is recommended, by Dr. Frank L. James, as superior to those in general use for inclosing preparations mounted in glycerine. The following are his directions for preparing it:

Dissolve gum damar in pure benzol sufficient to make a solution of the consistency of a thin syrup, and filter through absorbent cotton. Into a porcelain capsule put a small quantity of chemically pure oxide of zinc, free from moisture (a precaution which is best assured by heating the zinc in a muffle for a short time prior to using it), and, having previously wet it with a small quantity of benzol, add sufficient of the damar solution to make a paste the consistency of cream or a thick paint. Rub with the muller or pestle until perfectly smooth, and then pour into a stock bottle. Repeat the operation until a sufficient amount of the cement is obtained. The fluid should now be filtered through absorbent cotton to remove all of the grosser particles of the zinc which escaped the action of the muller. It may now be allowed to stand until the zinc subsides to the bottom. If the fluid has been used in proper proportion the zinc will occupy about half of the entire mass. In other words, the fluid and zinc should be in about equal proportions. If there be too much fluid, a portion may be decanted, while if there be too little the requisite amount may be added from the damar solution. The operation is finished by adding sufficient drying oil (boiled linseed or nut oil) to give the cement a proper toughness.

The cause of the so-called "creeping" of glycerine, leakage of cells, etc., is explained by the same author, as follows:

All of the cements which I have enumerated and described in the preceding chapters, with the exception of gold size, consist of some solid material or materials dissolved or held in suspension in a medium more or less volatile, the evaporation of which again leaves a solid mass. The exception, gold size, hardens partly, though very slightly, by evaporation, its solidification depending principally upon oxidation. In the process of hardening or setting, the bulk or mass of the cement is very materially altered, a decrease in volume occurring which is proportionate to the amount of volatile matter lost in drying. *The cement shrinks.*

Now, when a cell is properly finished it must be entirely filled with the mounting medium. If it is not so filled we are bound to have air bubbles, the *bête noir* of microscopists, which are not

only unsightly, but will, in process of time, ruin the mount. If the cell walls were not entirely dry when the cell was closed, it is plain that the process of shrinkage had not yet been completed, and that it is yet to occur to a greater or less extent. What is the inevitable result? The fluid within the cell is practically incompressible, yet pressure is brought upon it. It has no space within its container into which it can retreat, and consequently it must force its way out of it. This it does slowly and gradually. It may be some time before it is noticed, but it is bound to come. The cement gives way at its weakest point, and the fluid exudes—"creeps" out. It is discovered, washed off and a fresh ring of cement applied. This puts off the evil day a while, but in a few months the process has to be repeated. Meanwhile the pressure is continuously exerted, and minute quantities of the mounting medium gradually infiltrate the walls at fresh points; the cement disintegrates, scales, and splits off. The remedy proposed is—*Never use a cell until the cement walls are thoroughly dry and hard.*—*Nat. Druggist, April 4, 1885.*

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SCIENTIFIC NEWS.

— The two Portuguese explorers, Captain Capello and Commander Ivens, arrived at Cape Town on July 16th, and left again soon afterwards for Mossamedes, with the intention of returning to Europe via the Congo. They have traversed a region which no European had ever set foot in, as leaving Mossamedes in March, 1884, they reached Quillimane, on the eastern coast to the south of Mozambique, in May last, having traveled over 4500 miles of territory, 3000 miles of which were previously unexplored. They discovered the sources of the Lualaba, an affluent of the Congo, which has been so frequently referred to at recent geographical discussions. They also came upon a region which is extraordinarily rich in copper, this being the district of Yaranganga, situated between the Lualaba and the Luapula. They also made a discovery which may be of great use to commerce and science. It has often been remarked that the venomous African fly, the tsetsé, which did so much mischief to cattle in the southeast of Africa, and had almost extinguished trade between Delagoa bay and the Transvaal, had totally disappeared of late. Messrs. Capello and Ivens found that this fly was still very abundant further north, and that, as had often been stated before, it was always to be seen where there were plenty of elephants. Stanley, in the course of his travels, had observed the same phenomenon, and it follows, therefore, that the region explored by the two Portuguese travelers is rich in ivory.—*English Mechanic.*

— *Editor* AMERICAN NATURALIST:—Mr. M. C. Read has called my attention to the fact that he has been misrepresented by the text as it stands printed on p. 25 of my report upon petroleum to the Census office. No one can blame a man of Mr. Read's intelligence for objecting to being made responsible for the following sentence: "Mr. Read asserted that there were several bottomless pits of petroleum beneath an intensely hard, cherty limestone, very difficult to drill.". If the previous sentence is joined to the one just quoted and the words "Mr. Read" replaced by the word "who," the text would then stand as it was intended by myself. So many stupid and blundering changes were made in my text in Washington, that I am thankful no greater injustice has been done any of the numerous authors whom I have quoted. While many of these changes were discovered and the reading restored as originally written by myself, I am aware that some of them were overlooked and still remain. Very respectfully,

S. F. PECKHAM.

BRISTOL, R. I., *Oct. 5, 1885.*

— The Zoölogical Garden of Cincinnati is in a flourishing condition, and has some especial points of attraction. It possesses probably the finest mandrill in the world. He is twelve years old, and presents, from year to year, without diminution, the gorgeous colors which the adult male only exhibits. The largest polar and grizzly bears in America are in the collection, and there is a fine Thibetan bear. Among birds there is the Mantchurian pheasant (*Crossoptilum mantchuricum*), a species we have not previously seen in any American garden.

— The St. Louis Botanical Garden, or Shaw's Garden, is a feature of that city which deserves imitation elsewhere. It was established and is sustained by the liberality of Mr. Shaw, a private citizen. Full representations of the species of several of the genera peculiar to our south-western regions are to be found there, *e. g.*, yucca and agave. A fine private collection of plants is that of Mr. Wm. Brown. His palm house and fern house are highly ornamental, while in another house nearly if not quite all the species of Nepenthes are represented.

— Charles Wright, of Wethersfield, the well-known botanical collector, who graduated at Yale College in 1835, died suddenly of heart disease Aug. 11th, aged seventy-four years. Mr. Wright was one of the leading botanists of the country. He was employed by the Government in an expedition to Texas and Arizona and had also botanically explored Cuba. Last year Harvard College secured his collection of plants. Several American plants are named after him. He was formerly a valued contributor to the AMERICAN NATURALIST.

— The *Geological Magazine* is now twenty-one years old, and in view of the great usefulness of the magazine and the unrequited labors of the chief editor, Dr. H. Woodward, in charge of the palæontological department of the British Museum, his friends are subscribing funds to present him with a testimonial, of which a piece of plate will form a part. We should be happy to receive and forward any subscriptions from friends of the editor in the United States.

— We are glad to learn, from an article by Dr. C. T. Hudson in the Journal of the Royal Microscopical Society, that a monograph of the Rotifera, by Mr. P. H. Gosse and himself, is in course of preparation. Such a work will be warmly welcomed by microscopists in this country.

— Professor W. C. Kerr, State geologist of North Carolina for eighteen years, and more recently connected with the United States Geological Survey, died at Asheville, N. C., Aug. 9th, of consumption. He was an excellent observer and a most genial, companionable man.

— Dr. Henry William Reichardt, professor of botany in the University of Vienna, died while in a fit of temporary insanity lately. The majority of his papers were published in the Journal of the Vienna Academy. He was born at Iglau in 1835.

—Messrs. M. Schlosser and Otto Meyer, of the Yale College Museum of Palæontology, have returned to Germany. These gentlemen have made important contributions to geology and palæontology.

— Professor Worsae, the distinguished Danish archæologist and curator of the vast museum at Copenhagen, died in August.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Philadelphia Academy of Natural Sciences, June 9.—Mr. Ford referred to the presence of *Littorina irrorata* at South Atlantic City, and stated his belief that there were but three generations of the species at that locality. He also exhibited specimens of *Exogyra forniculata* from Kansas, the first examples of the species known to have been collected in the State.

Dr. G. A. Koenig described a mineral allied to franklinite, and found at Franklin, N. J. The zinc of franklinite is replaced by iron to such an extent as to reduce it from twenty or thirty to one and a half per cent, the manganese remaining unchanged. He proposed to name it manganoferrite.

June 30.—Dr. H. C. McCook gave an account of the life-history of the seventeen-year locust.

Professor W. B. Scott presented for publication an article upon *Cervalces americanus*, the fossil deer, from the Quaternary of New Jersey.

July 14.—Mr. Chas. Morris, referring to a criticism upon his recently published paper on the development of the hard parts of fossils, stated that the usually received idea of the organic origin of Archæan limestones was but an opinion. At the present time many springs were depositing carbonate of lime mechanically, and it is possible, and even probable, that the Laurentian seas contained as great an excess of this salt as do these modern springs. Professor T. Sterry Hunt is of this opinion, and considers the phosphates as also of mechanical deposition. Inorganic chemistry was probably much more active at that period than now, and reactions may have taken place of which no trace remains except in the conditions of these early strata.

July 28.—Mr. G. H. Parker described the anatomy of the Cecropia moth. The proboscis is small and the œsophagus thread-like, indicating that the imago takes little nourishment. The speaker stated his conviction that the three glands which pour a secretion into the oviduct, and the function of which was by a recent writer said to be unknown, secrete an adhesive material which serves to secure the eggs to the object on which they are deposited.

Linnæan Society, Lancaster, Pa., June 27.—There were a large number of donations to the museum, among them a specimen of the nest of the Tarantula, containing the insect, from California, by Abram Summy; and the habitaculums of the Cicada from the Moravian burying-ground, donated by S. M. Sener. They are not as perfect as those secured in 1868 on the premises of George Hensel. This is perhaps owing to the character of the soil. Those of the former year were found in a soil of clay and sand, whilst those in the burying-ground were in a dark, loamy soil. This is an interesting confirmation of an observation that had heretofore never been recorded except in reference to Lancaster city.

It was announced that the twenty-four new plants collected in Lancaster county last year, by W. P. King, are in the hands of Dr. T. C. Porter, who determines them to be correctly named. Miss Baker exhibited specimens of "lychee," a fruit sold by the Chinese.